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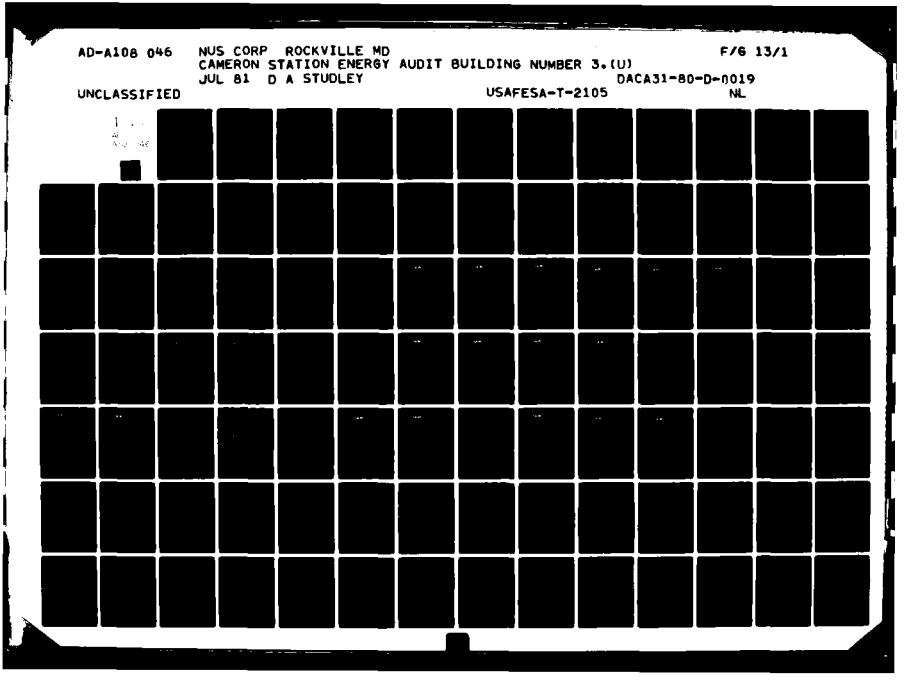

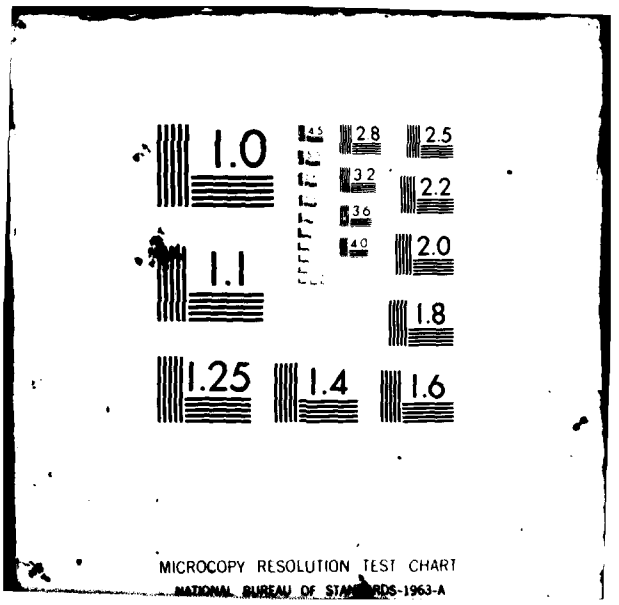
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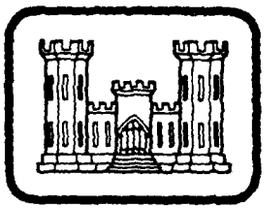

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FACILITIES ENGINEERING SUPPORT AGENCY

FESA-T-2105

Cameron Station Energy Audit, Building No. 3

NUS Corporation
4 Research Place
Rockville, Maryland 20850

September 1981

Final Report

Prepared for:
US Army Facilities Engineering Support Agency
Technology Support Division
Fort Belvoir, VA 22060

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Comments

Comments on the contents of this report are encouraged, and should be submitted to:

Commander and Director
US Army Facilities Engineering Support Agency
Fort Belvoir, Virginia 22060

CAMERON STATION ENERGY AUDIT

BUILDING NO. 3

PREPARED UNDER

CONTRACT NO. DACA 31-80-D-0019

AMENDMENT NO. 00005

PREPARED FOR
U.S. DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
FACILITIES ENGINEERING SUPPORT AGENCY
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The results of an energy audit on Building No. 3 Cameron Station are detailed herein. The report investigates various systems which consume energy in order to identify energy conservation opportunities. These selected systems include HVAC equipment, temperature and humidity controls, heat recovery equipment, building insulation, ventilation rate reduction, lighting systems and domestic hot water. The study analyzes energy conservation opportunities to determine which are cost effective and produce adequate energy savings.

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CAMERON STATION ENERGY AUDIT

BUILDING NO. 3

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CAMERON STATION ENERGY AUDIT

BUILDING NO. 3

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1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report is in response to Contract No. DACA 31-80-D-0019, Amendment 00005 with the U.S. Department of the Army to perform an energy conservation study on building No. 3 of Cameron Station. During the early 60's, building No. 3 was converted to administrative office space, after having served as a warehouse for many years. All of the office space is contained on a single floor with a total area of approximately 130,000 sq. ft. The building envelope consists of windowless, three course brick walls with a pitched roof that is separated from occupied space by a suspended ceiling. The 21 HVAC units located in the plenum space above the ceiling, provide comfort conditioning thru the use of steam heating and chilled water cooling.

1.2 OBJECTIVES

The objectives of this energy conservation study are as follows:

a. Investigate various systems which consume energy in order to identify energy conservation opportunities. These selected systems include HVAC equipment, temperature and humidity controls, heat recovery equipment, building insulation, ventilation rate reduction, lighting systems and domestic hot water.

b. Analyze energy conservation opportunities to determine which are cost effective and produce adequate energy savings. Provide design concepts, cost estimates and economic analyses to quantify the implementation of the proposed measures.

1.3 CONCLUSION AND FINDINGS

The results of the study, indicate the potential for saving 2787.5 MBTU/yr (10^6 BTU/yr) or $27,206 per year (FY81) with a total capital investment of $117,600 and a survey cost of $15,600. The savings can be

realized from both capital intensive and non-capital intensive modifications. The energy saving measures represent 29 percent of the present energy costs. See Table 1 for a summary of modifications and economic analyses. See Section 3 of this report for a detailed discussion of each modification.

Many of the non-capital intensive modifications are maintenance deficiencies that have resulted in a greater consumption model than the original design. The maintenance items include the following:

a. Uncalibrated and faulty economizer controls.

b. Sticky or disconnected damper operators.

c. Air Handling Unit (AHU) time-clocks without all or any of the necessary devices to trip or actuate unit operation. Several of the time-clocks were installed but never set up.

NUS feels that these maintenance deficiencies should be remedied regardless of the economic analysis. However the analysis does show economic benefits from correcting these problems.

Due to the structural and mechanical similarities among all eight major buildings at Cameron Station, NUS feels that benefits similar to those predicted for building No. 3 could be realized by investigating the proposed modifications' applicability to the other buildings. Adding insulation, calibrating controls and reducing ventilation rates will all lead to energy savings similar to those expected from building No. 3.

In addition, NUS feels that adding individual steam, cooling water, and electricity metering capabilities for each building will increase control over the energy consumption profile. Metering energy consumption on building 3 both before and after the modifications are implemented will increase the accuracy of the energy analysis on the remaining seven buildings, thereby helping Cameron Station reach its energy conservation goals.

During the energy analysis, several energy conservation measures were observed that cannot be implemented without either modifying all of the buildings or modifying the central plants. The following observations are basewide deficiencies that could be investigated.

a. One possible modification is to add insulation to the steam condensate return system. The existing condensate lines have no insulation and are currently wasting approximately 100 BTU's per pound of steam generated. In 1979 the central steam generating plant produced 59.33 million lbs. of steam. Assuming that the addition of insulation could save 50 BTU per pound of steam, a yearly saving of 2967 MBTU/yr or $25,300/yr (FY 81) would be realized.

b. Another possible modification is to raise the chilled water temperature. A higher chilled water temperature saves energy by (1) decreasing the heat gain to piping (10-15 percent of the piping gains) and (2) increasing the refrigeration equipment efficiency. The current chilled water plant provides $40^{\circ}F$ water throughout the entire cooling season. The chilled water controller should be adjusted to maintain the highest possible temperature; $55^{\circ}F$ should be the minimum to comply with the Emergency Building Temperature Restriction. During periods of high outdoor humidity or peak cooling load, the temperature of the chilled water could be gradually lowered to $45^{\circ}F$ or $40^{\circ}F$. As a general rule, efficiency increases 1½ percent for each degree of increase in chilled water temperature. Utilizing a $50^{\circ}F$ chilled water temperature could save up to 2000 MBTU/yr or $6,660/yr (FY 81).

TABLE 1

SUMMARY OF ENERGY CONSERVATION MEASURES

Recommendation	Energy Savings (FY 81)	Energy Savings Purchased Electric Power	Capital Investment (Dollars)	Simple Payback Period (Yr.)	Discounted Benefit/Cost Ratio	E/C Ratio
Modification No. 1 Alternate A - Add 9" of Ceiling Insulation	1160 MBTU/Yr. $9,131/Yr.	150 MBTU/Yr.	$72,300	7.92	2.37	16.04
Modification No. 1 Alternate B - Add 6" of Ceiling Insulation	1060 MBTU/Yr. $8,434/Yr.	121 MBTU/Yr.	$45,900	5.44	3.46	23.1
Modification No. 1 Alternate C - Add 3" of Ceiling Insulation	805 MBTU/Yr. $6,468/Yr.	78 MBTU/Yr.	$38,520	5.96	3.16	20.9
Modification No. 2 Replace Economizer Controls and Reduce Ventilation	1230 MBTU/Yr. $9,274/Yr.	239 MBTU/Yr.	$33,000	3.56	3.4	37.3
Modification No. 3 Add Outdoor Air Shut-off Damper and Steam Isolation Valve	230 MBTU/Yr. $1,961/Yr.	--	$11,750	5.99	2.06	19.6
Modification No. 4 Reschedule AHU Operation	157 MBTU/Yr. 117.4 x 10^3 KWH/Yr. $6,750/Yr.	1362 MBTU/Yr.	--	--	--	--

T. E 1

SUMMARY OF ENERGY CONSERVATION MEASURES

Recommendation	Energy Savings (FY 81)	Energy Savings Purchased Electric Power	Capital Investment (Dollars)	Simple Payback Period (Yr.)	Discounted Benefit/Cost Ratio	E/C Ratio
Modification No. 5 Relocate Thermostats (7 Thermostats)	10.5 MBTU/Yr. $90/Yr.	--	$560	6.2	2.1	18.8
TOTAL: = (Using 9" Insulation)	$27,206 2787.5 MBTU/Yr.	--	$117,610 + Survey Cost = $133,210	4.9		

CAMERON STATION ENERGY AUDIT BUILDING NO. 3

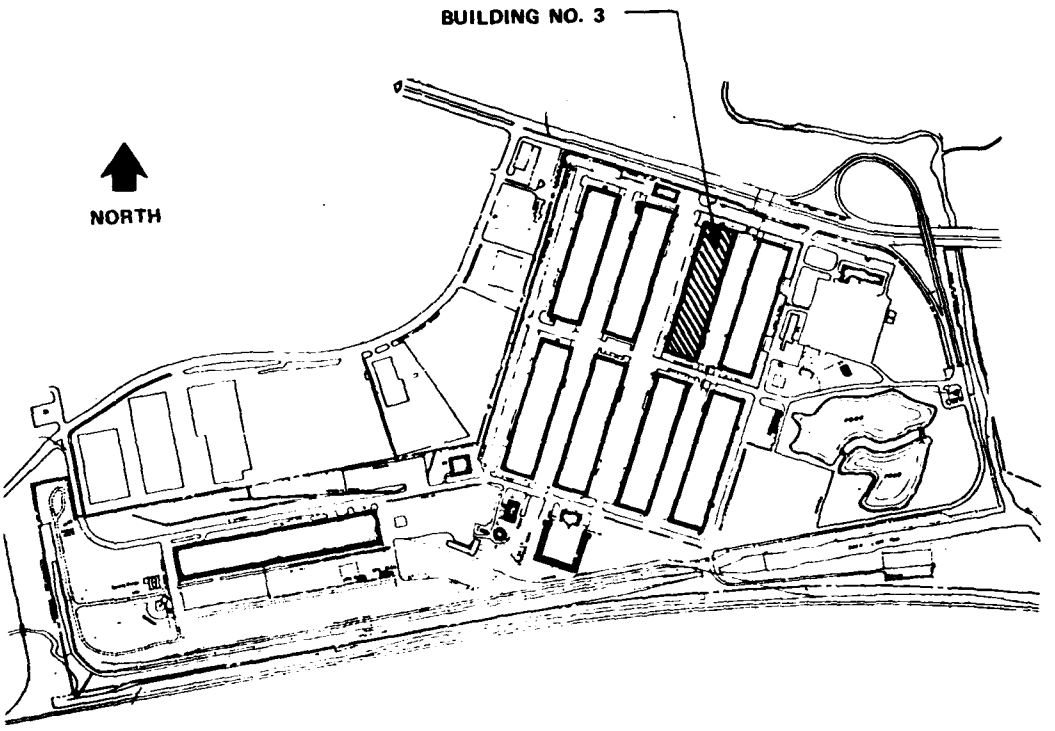


FIGURE 1
SITE PLAN

CAMERON STATION ENERGY AUDIT BUILDING NO. 3

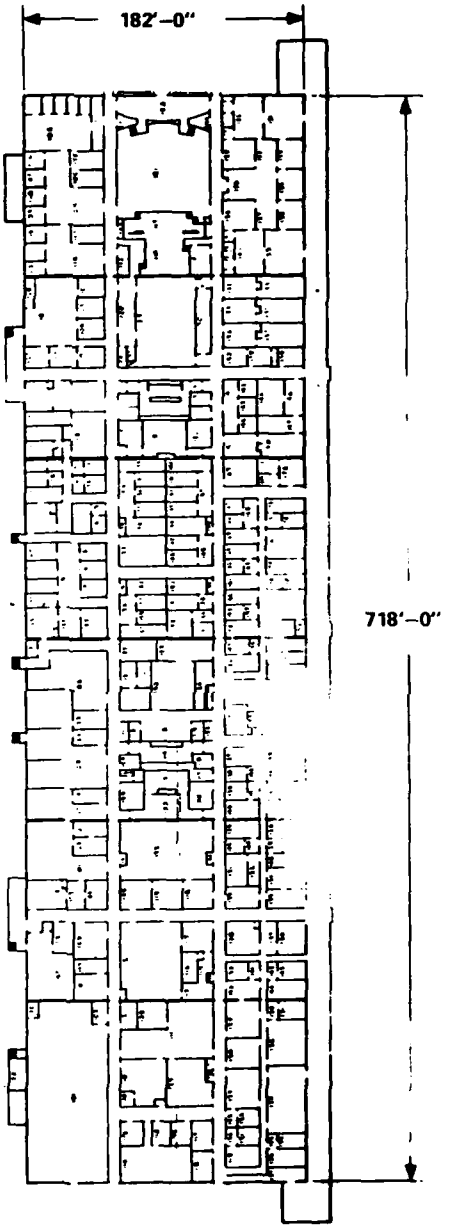


FIGURE 2
FLOOR PLAN

2.0 CURRENT ENERGY PROFILE

2.1 TOTAL ENERGY CONSUMPTION

Figure 3 shows graphically the current energy consumption for building 3 of Cameron Station. The quantity of energy consumed is based on detailed review of the building drawings, visual inspection, analysis of the building dynamics, and limited records from the existing monitoring equipment. The eight major buildings at Cameron Station are not individually monitored for their consumption of electricity, steam, and cooling water. Recently, a kilowatt-hour meter was installed to monitor the combined load for buildings 3 and 4. Figure 4 shows graphically the total cost of energy consumption for fiscal year 1980. The total energy consumption is 10,355 MBTU/yr. at a present cost of $92,290. With a combined inflation and escalation rate of 14 percent per year, the estimated energy cost for building No. 3 in 1990 will be $342,139. Implementing all of the proposed energy conservation measures will reduce the energy cost for 1990 to $242,280.

CAMERON STATION ENERGY AUDIT BUILDING NO. 3

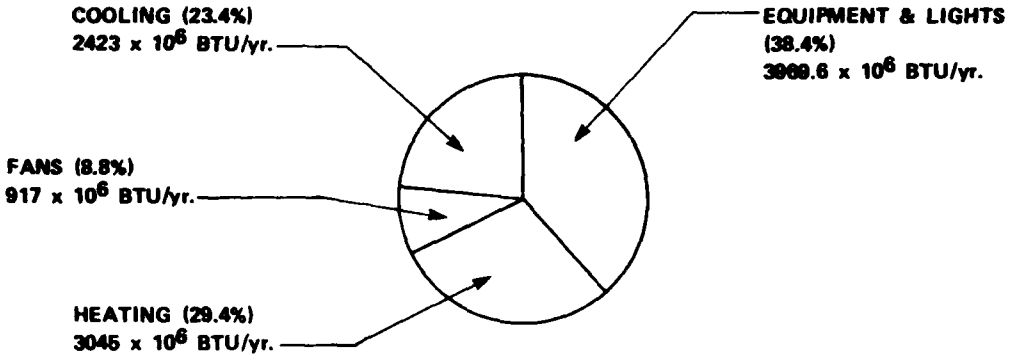


FIGURE 3
ENERGY PROFILE (MILLION BTU'S/yr.)
TOTAL CONSUMPTION = 10,355 MBTU/yr.

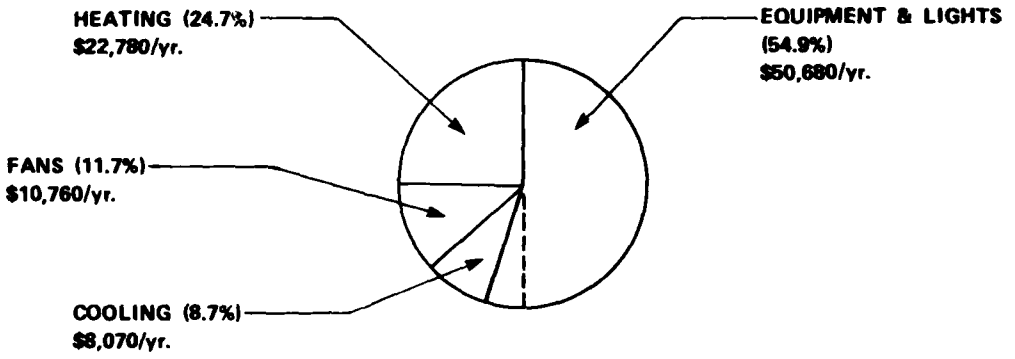


FIGURE 4
ENERGY COST PROFILE (DOLLARS)
TOTAL COST = $92,290/yr.

3.0 MODIFICATIONS AND RECOMMENDATIONS

3.1 MODIFICATION NO. 1 - ADD INSULATION TO CEILING

During the field survey, it was observed that the only portion of the building envelope requiring thermal improvement is the space above the suspended ceiling. The exterior walls provide an overall U-Value = 0.281 BTU/hr/^{o}F/S.F., which is lower than the maximum U-Value required by ASHRAE Std. 90-75 (Energy Conservation in New Building Design). The low U-Valve is due to lack of windows on the exterior walls. However, the composite ceiling U-Value is greater than maximum required in ASHRAE Std. 90-75. The existing insulation is decayed and has settled to an average thickness of approximately 1 inch.

Adding insulation to the suspended ceiling saves energy by (1) decreasing the heat flow rate thru the ceiling during the occupied hours, and, (2) keeping the heat within the space during unit shut-down. However, adding insulation increases the quantity of heat required to protect piping in the plenum space freezing.

The station is currently attempting to reduce energy consumption basewide by shutting the steam plant down during the evening hours. As a result of this procedure several pipes in the plenum space have frozen, fortunately with no damage to the equipment below.

Freeze-protection for the overhead piping was originally provided with steam unit heaters located in the plenum space. To correct the freezing problems the base will have to either provide continuous steam to these heaters or provide steam at a lower pressure during the evenings or install electric space heaters. During the analysis of the effects of adding insulation, the additional heat required to the plenum was deducted from the savings, but the capital costs of providing a means of freeze-protection was not included because it is an existing problem that must be remedied.

Figure 5 shows the overall effects of adding various thicknesses of insulation. Adding R-19 insulation (typically 6 inches) saves 1060 MBTU/yr or $8,434/yr (FY 81), while adding R-30 insulation (typically 9 inches) saves 1160 MBTU/yr or $9,131/yr (FY 81). The Economic Analysis Summary Forms show the 6 inch insulation has the best E/C ratio and pay-back period.

ENERGY SAVINGS FROM ADDING VARIOUS THICKNESSES OF INSULATION TO THE SUSPENDED CEILING

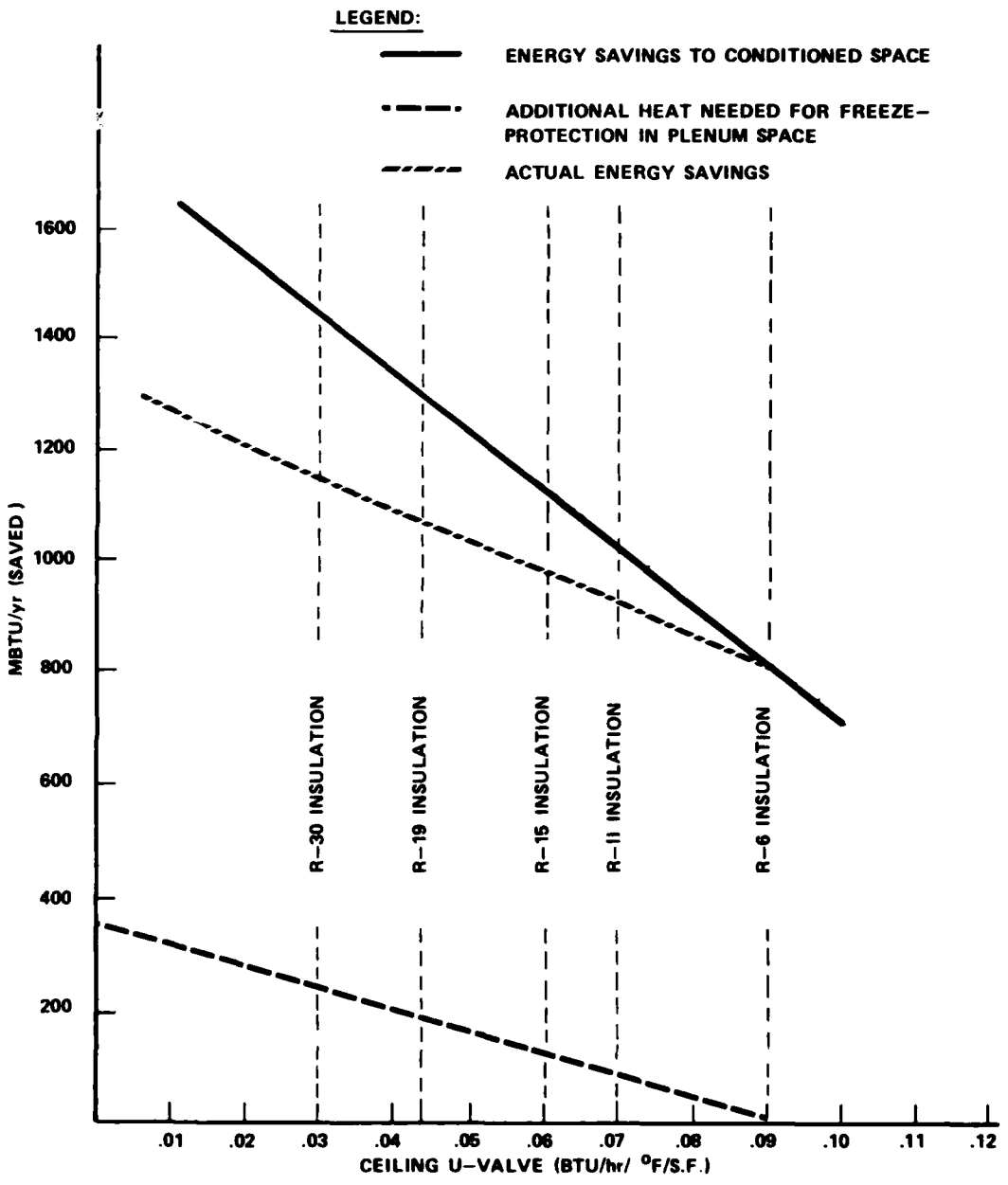


FIGURE 5

TABLE 2

ECONOMIC ANALYSIS SUMMARY

Location: Cameron Station Energy Audit, Bldg. No. 3 FY 81

Project: Modification No. 1 (Alternate C) Add 3" of Ceiling Insulation

Economic Life 25 Yrs. Date Prepared 1/8/81 Prepared by D. Studley

COSTS

1.	Non-Recurring Initial Capital Costs:	
	a. CWE	$ 38,520
	b. Design	$ 2,311
	c.	$
	d. Total	$ 40,831

BENEFITS

2.	Recurring Benefit/Cost Differential Other than Energy:	
	a. Annual Labor Decrease (+)/Increase (-)	$ 0
	b. Annual Material Decrease (+)/Increase (-)	$ 0
	c. Other Annual Decrease (+)/Increase (-)	$ 0
	d. Total Costs	$ 0
	e. 10% Discount Factor	$ 0
	f. Discounted Recurring Cost (d x e)	$ 0
3.	Recurring Energy Benefit/Costs:	
	a. Type of Fuel: No.6 Fuel Oil	
	(1) Annual Energy Decrease (+)/Increase (-)	724 MBTU/Yr.
	(2) Cost per MBTU	$ 8.53/MBTU
	(3) Annual Dollar Decrease/Increase ((1)x(2))	$ 6176/Yr.
	(4) Differential Escalation Rate (8 %) Factor	20.050
	(5) Discounted Dollar Decrease/Increase (3)x(4)	$ 123,829
	b. Type of Fuel: Electricity-Cooling	
	(1) Annual Energy Decrease (+)/Increase (-)	81 MBTU/Yr.
	(2) Cost per MBTU	$ 3.60/MBTU
	(3) Annual Dollar Decrease/Increase ((1)x(2))	$ 292/Yr.
	(4) Differential Escalation Rate (7 %) Factor	18.049
	(5) Discounted Dollar Decrease/Increase ((3)x(4))	$ 5,270
	c. Type of Fuel:	
	(1) Annual Energy Decrease (+)/Increase (-)	
	(2) Cost per MBTU	$
	(3) Annual Dollar Decrease/Increase ((1)x(2))	$
	(4) Differential Escalation Rate (%) Factor	
	(5) Discounted Dollar Decrease/Increase ((3)x(4))	$
	d. Discounted Energy Benefits (3a(5)+3b(5)+3c(5)+3d(5))	$ 129,099
4.	Total Benefits (Sum 2f+3d)	$ 129,099
5.	Discounted Benefit/Cost Ratio (Line 4/Line 1d)	3.16
6.	Total Annual Energy Savings (3a(1)+3b(1)+3c(1))	805 MBTU/Yr.
7.	E/C Ratio (Line 6 ÷ Line 1a/1000)	20.9
8.	Annual $ Savings (2d+3a(3)+3b(3)+3c(3))	$ 6,468/Yr.
9.	Pay-Back Period ((Line 1a - Salvage)+Line 8)	5.96 Yr.

TABLE 3

ECONOMIC ANALYSIS SUMMARY

Location: Cameron Station Energy Audit, Bldg. No. 3 FY 81

Project: Modification No. 1 (Alternate B) Add 6" of Ceiling Insulation

Economic Life 25 Yrs. Date Prepared 1/8/81 Prepared by D. Studley

COSTS

1.	Non-Recurring Initial Capital Costs:	
	a. CWE	$ 45,900
	b. Design	$ 2,754
	c. _____	$ _____
	d. Total	$ 48,654
	BENEFITS	
2.	Recurring Benefit/Cost Differential Other than Energy:	
	a. Annual Labor Decrease (+)/Increase (-)	$ _____
	b. Annual Material Decrease (+)/Increase (-)	$ _____
	c. Other Annual Decrease (+)/Increase (-)	$ _____
	d. Total Costs	$ _____
	e. 10% Discount Factor	$ _____
	f. Discounted Recurring Cost (d x e)	$ _____
3.	Recurring Energy Benefit/Costs:	
	a. Type of Fuel: No. 6 Fuel Oil	
	(1) Annual Energy Decrease (+)/Increase (-)	935 MBTU/Yr.
	(2) Cost per MBTU	$ 8.53/MBTU
	(3) Annual Dollar Decrease/Increase ((1)x(2))	$ 7,976/Yr.
	(4) Differential Escalation Rate (8 %) Factor	20.050
	(5) Discounted Dollar Decrease/Increase (3)x(4)	$ 159,919
	b. Type of Fuel: Electricity	
	(1) Annual Energy Decrease (+)/Increase (-)	125 MBTU/Yr.
	(2) Cost per MBTU	$ 3.6/MBTU
	(3) Annual Dollar Decrease/Increase ((1)x(2))	$ 458/Yr.
	(4) Differential Escalation Rate (7 %) Factor	18.049
	(5) Discounted Dollar Decrease/Increase ((3)x(4))	$ 8,266
	c. Type of Fuel: _____	
	(1) Annual Energy Decrease (+)/Increase (-)	_____
	(2) Cost per MBTU	$ _____
	(3) Annual Dollar Decrease/Increase ((1)x(2))	$ _____
	(4) Differential Escalation Rate (___ %) Factor	_____
	(5) Discounted Dollar Decrease/Increase ((3)x(4))	$ _____
	d. Discounted Energy Benefits (3a(5)+3b(5)+3c(5)+3d(5))	$ 168,185
4.	Total Benefits (Sum 2f+3d)	$ 168,185
5.	Discounted Benefit/Cost Ratio (Line 4/Line 1d)	3.46
6.	Total Annual Energy Savings (3a(1)+3b(1)+3c(1))	1060 MBTU/Yr.
7.	E/C Ratio (Line 6 ÷ Line 1a/1000)	23.1
8.	Annual $ Savings (2d+3a(3)+3b(3)+3c(3))	$ 8,434/Yr.
9.	Pay-Back Period ((Line 1a - Salvage)+Line 8)	5.44 Yr.

TABLE 4

ECONOMIC ANALYSIS SUMMARY

Location: Cameron Station Energy Audit, Bldg. No. 3 FY 81

Project: Modification No. 1 (Alternate A) Add 9" of Ceiling Insulation

Economic Life 25 Yrs. Date Prepared 1/8/81 Prepared by D. Studley

COSTS		
1. Non-Recurring Initial Capital Costs:		
a. CWE		$ 72,300
b. Design		$ 4,338
c.		$
d. Total		$ 76,638
BENEFITS		
2. Recurring Benefit/Cost Differential Other than Energy:		
a. Annual Labor Decrease (+)/Increase (-)		$
b. Annual Material Decrease (+)/Increase (-)		$
c. Other Annual Decrease (+)/Increase (-)		$
d. Total Costs		$
e. 10% Discount Factor		$
f. Discounted Recurring Cost (d x e)		$
3. Recurring Energy Benefit/Costs:		
a. Type of Fuel: No. 6 Fuel Oil		
(1) Annual Energy Decrease (+)/Increase (-)		1005 MBTU/Yr.
(2) Cost per MBTU		$ 8.53/MBTU
(3) Annual Dollar Decrease/Increase ((1)x(2))		$ 8,573/Yr.
(4) Differential Escalation Rate (8 %) Factor		20.050
(5) Discounted Dollar Decrease/Increase (3)x(4)		$ 171,889
b. Type of Fuel: Electricity		
(1) Annual Energy Decrease (+)/Increase (-)		155 MBTU/Yr.
(2) Cost per MBTU		$ 3.6/MBTU
(3) Annual Dollar Decrease/Increase ((1)x(2))		$ 558/Yr.
(4) Differential Escalation Rate (7 %) Factor		18.049
(5) Discounted Dollar Decrease/Increase ((3)x(4))		$ 10,071
c. Type of Fuel:		
(1) Annual Energy Decrease (+)/Increase (-)		
(2) Cost per MBTU		$
(3) Annual Dollar Decrease/Increase ((1)x(2))		$
(4) Differential Escalation Rate (%) Factor		
(5) Discounted Dollar Decrease/Increase ((3)x(4))		$
d. Discounted Energy Benefits (3a(5)+3b(5)+3c(5)+3d(5))		$ 181,960
4. Total Benefits (Sum 2f+3d)		$ 181,960
5. Discounted Benefit/Cost Ratio (Line 4/Line 1d)		2.37
6. Total Annual Energy Savings (3a(1)+3b(1)+3c(1))		1160 MBTU
7. E/C Ratio (Line 6 ÷ Line 1a/1000)		16.04
8. Annual $ Savings (2d+3a(3)+3b(3)+3c(3))		$ 9,131/Yr.
9. Pay-Back Period ((Line 1a - Salvage)+Line 8)		7.92

3.2 MODIFICATION NO. 2 - REPAIR ECONOMIZER CONTROLS AND REDUCE VENTILATION RATES

Many of the present economizer controls for the air handling units are faulty, out of calibration, or disconnected. The economizer cycle can provide approximately 649 MBTU/yr of free cooling. During the cooling cycle, the economizer system admits outside air when enthalpy of the outside air is lower then the enthalpy of the return air. For the purpose of analysis, (presented in Appendix A) it was assumed that the existing economizer controls are not taking advantage of 38 percent of the free cooling available or 247 MBTU/yr. This value is probably very conservative since the uncalibrated and faulty controls could be increasing the building cooling load by erroneously admitting high enthalpy outdoor air.

Reducing the quantity of outdoor ventilation air can be accomplished during the replacement of the economizer controls and operators. The minimum outdoor air flow rate is established by the position set by the damper operator. Flow variations can be achieved by adjusting the damper linkage or shifting the location of the operator. Many of the existing operators are either completely disconnected or sticky.

Since the operators do not all return to their minimum position, the air handling units are introducing more outdoor air than the design value. The estimated load for the existing ventilation rate is 1461 MBTU/yr using a value of 53,100 BTU per year per cfm. A comparison of the existing and design ventilation rates to the minimum rates set forth in ASHRAE Std. 62-73 (Standards for Natural and Mechanical Ventilation) reveals that the design value exceeds the current standard by 7210 CFM. The existing conditions exceed the current standard by 18,510 CFM. Reducing the ventilation rates to comply with todays standards (15 CFM per person) can save 983 MBTU/yr.

Replacing the economizer controls and reducing the ventilation rates can save 1230 MBTU/yr or $9,274/yr (FY 81). The total capital investment to replace 100 percent of the economizer controls and operators is $34,980 (FY 81) which results in a simple payback period of 3.56 years.

TABLE 5

ECONOMIC ANALYSIS SUMMARY

Location: Cameron Station Energy Audit, Bldg. No. 3 FY 81

Project: Modification No. 2 - Replace Economizer Controls and Reduce Ventilation

Economic Life 15 Yrs. Date Prepared 1/12/81 Prepared by D. Studley

COSTS		
1. Non-Recurring Initial Capital Costs:		
a. CWE		$ 33,000
b. Design		$ 1,980
c.		$
d. Total		$ 34,980
BENEFITS		
2. Recurring Benefit/Cost Differential Other than Energy:		
a. Annual Labor Decrease (+)/Increase (-)		$
b. Annual Material Decrease (+)/Increase (-)		$
c. Other Annual Decrease (+)/Increase (-)		$
d. Total Costs		$
e. 10% Discount Factor		$
f. Discounted Recurring Cost (d x e)		$
3. Recurring Energy Benefit/Costs:		
a. Type of Fuel: Electricity-Cooling		
(1) Annual Energy Decrease (+)/Increase (-)		247 MBTU/Yr.
(2) Cost per MBTU		$ 3.6/MBTU
(3) Annual Dollar Decrease/Increase ((1)x(2))		$ 889/Yr.
(4) Differential Escalation Rate (7 %) Factor		12.278
(5) Discounted Dollar Decrease/Increase (3)x(4)		$ 10,915
b. Type of Fuel: No. 6 Fuel Oil		
(1) Annual Energy Decrease (+)/Increase (-)		983 MBTU/Yr.
(2) Cost per MBTU		$ 8.53/MBTU
(3) Annual Dollar Decrease/Increase ((1)x(2))		$ 8,385/Yr.
(4) Differential Escalation Rate (%) Factor		13.112
(5) Discounted Dollar Decrease/Increase ((3)x(4))		$ 109,944
c. Type of Fuel:		
(1) Annual Energy Decrease (+)/Increase (-)		
(2) Cost per MBTU		$
(3) Annual Dollar Decrease/Increase ((1)x(2))		$
(4) Differential Escalation Rate (%) Factor		
(5) Discounted Dollar Decrease/Increase ((3)x(4))		$
d. Discounted Energy Benefits (3a(5)+3b(5)+3c(5)+3d(5))		$ 120,859
4. Total Benefits (Sum 2f+3d)		$ 120,859
5. Discounted Benefit/Cost Ratio (Line 4/Line 1d)		3.4
6. Total Annual Energy Savings (3a(1)+3b(1)+3c(1))		1230 MBTU/Yr.
7. E/C Ratio (Line 6 ÷ Line 1a/1000)		37.3
8. Annual $ Savings (2d+3a(3)+3b(3)+3c(3))		$ 9,274/Yr.
9. Pay-Back Period ((Line 1a - Salvage)+Line 8)		3.56 Yr.

Replacing the economizer controls and reducing the ventilation rates can save 1230 MBTU/yr or $9,274/yr (FY 81). The total capital investment to replace 100 percent of the economizer controls and operators is $34,980 (FY 81) which results in a simple payback period of 3.56 years.

3.3 MODIFICATION NO. 3 - ADD SHUT-OFF DAMPER TO OUTDOOR AIR INTAKE AND CLOSE STEAM COIL ON UNIT SHUT- DOWN

Figure 6 shows the arrangement of the outdoor air intake and that the current steam coil operation allows energy to be lost by (1) venting conditioned air to the ambient during unit shut down, (increasing the infiltration rate due to thermal stack effect), and (2) venting heat extracted from the steam coil directly to the outdoors when the air handling unit is shut down. The full open steam coil wastes approximately 171 MBTU/yr Even when steam is not available to the coil, 39 MBTU/yr is wasted through the outdoor intake due to the increased infiltration rates caused by thermal stack effect.

230 MBTU/yr can be saved by (1) adding shut-off dampers to the outdoor air intakes and, (2) adding the necessary controls to close the steam control valves on unit shut-down. The steam coil can be shut off either by adding a solenoid valve to the steam line or by adding a three-way solenoid valve to the pneumatic control line to drive the valve closed. Implementing Modification 3 will save $1961/yr (FY 81) at a capital investment of $12,460.

CAMERON STATION ENERGY AUDIT BUILDING NO. 3

MODIFICATION NO. 3 – ADD SHUT-OFF DAMPER TO OUTDOOR – AIR INTAKE AND CLOSE STEAM CONTROL VALVE ON UNIT SHUT-DOWN

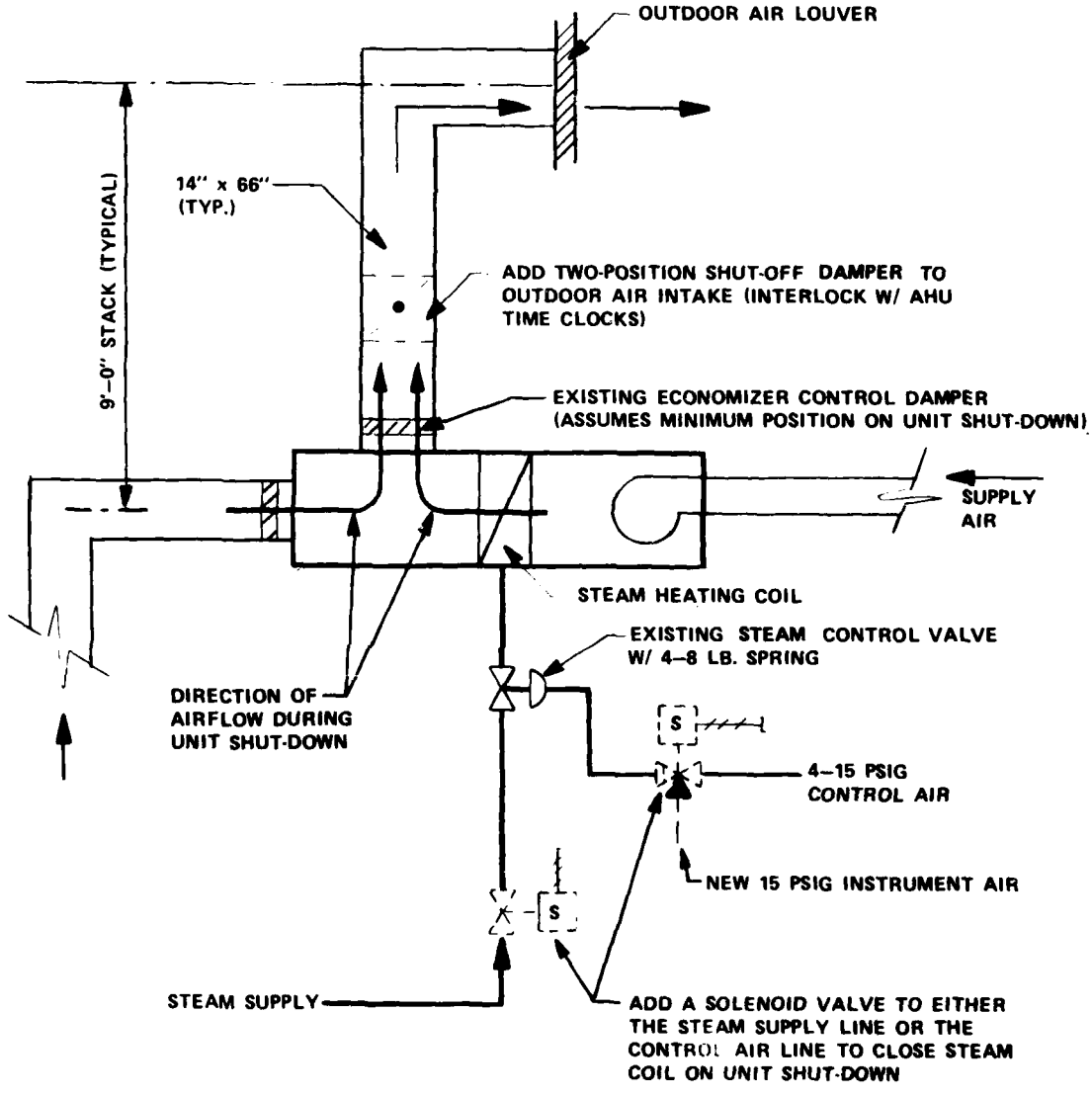


FIGURE 6

TABLE 6

ECONOMIC ANALYSIS SUMMARY

Location: Cameron Station Energy Audit Bldg. No. 3 FY 81

Project: Modification No. 3 - Add Outdoor Air Shut-Off Damper and Steam Isolation Valve

Economic Life 15 Yrs. Date Prepared 1/16/81 Prepared by D. Studley

COSTS

1.	Non-Recurring Initial Capital Costs:	
	a. CWE	$ 11,750
	b. Design	$ 710
	c. _____	$ _____
	d. Total	$ 12,460

BENEFITS

2.	Recurring Benefit/Cost Differential Other than Energy:	
	a. Annual Labor Decrease (+)/Increase (-)	$ _____
	b. Annual Material Decrease (+)/Increase (-)	$ _____
	c. Other Annual Decrease (+)/Increase (-)	$ _____
	d. Total Costs	$ _____
	e. 10% Discount Factor	$ _____
	f. Discounted Recurring Cost (d x e)	$ _____
3.	Recurring Energy Benefit/Costs:	
	a. Type of Fuel: No. 6 Fuel Oil	
	(1) Annual Energy Decrease (+)/Increase (-)	230 MBTU/Yr.
	(2) Cost per MBTU	$ 8.53/MBTU
	(3) Annual Dollar Decrease/Increase ((1)x(2))	$ 1961/Yr.
	(4) Differential Escalation Rate (8 %) Factor	13.112
	(5) Discounted Dollar Decrease/Increase (3)x(4)	$ 25,724
	b. Type of Fuel: _____	
	(1) Annual Energy Decrease (+)/Increase (-)	_____
	(2) Cost per MBTU	$ _____
	(3) Annual Dollar Decrease/Increase ((1)x(2))	$ _____
	(4) Differential Escalation Rate (___%) Factor	_____
	(5) Discounted Dollar Decrease/Increase ((3)x(4))	$ _____
	c. Type of Fuel: _____	
	(1) Annual Energy Decrease (+)/Increase (-)	_____
	(2) Cost per MBTU	$ _____
	(3) Annual Dollar Decrease/Increase ((1)x(2))	$ _____
	(4) Differential Escalation Rate (___%) Factor	_____
	(5) Discounted Dollar Decrease/Increase ((3)x(4))	$ _____
	d. Discounted Energy Benefits (3a(5)+3b(5)+3c(5)+3d(5))	$ 25,724
4.	Total Benefits (Sum 2f+3d)	$ 25,724
5.	Discounted Benefit/Cost Ratio (Line 4/Line 1d)	2.06
6.	Total Annual Energy Savings (3a(1)+3b(1)+3c(1))	230 MBTU/Yr.
7.	E/C Ratio (Line 6 ÷ Line 1a/1000)	19.6
8.	Annual $ Savings (2d+3a(3)+3b(3)+3c(3))	$ 1,961/Yr.
9.	Pay-Back Period ((Line 1a - Salvage)+Line 8)	6.0 Yr.

3.4 MODIFICATION NO. 4 - RESCHEDULE AHU OPERATION

Existing schedule - AHU Operation 5:00 A.M. to 5:00 P.M.

Proposed Schedule - AHU Operation 6:00 A.M. to 5:00 P.M. (Heating Season)

AHU Operation 8:00 A.M. to 5:00 P.M. (Cooling Season)

Each of the 21 air handling units have recently been modified to include a seven day time-clock to reduce fan energy. However, a large portion of the time-clocks have never been set up, thereby allowing several units to run continuously. Figure 3 shows that the fans consume 8.8 percent of the total energy costs or $10,760/yr (FY 81). Resetting the time-clocks to their existing schedule (5:00 A.M. to 5:00 P.M.) will save an estimated 95,000 KWH/year or $3800/yr, (FY 81).

The air handling units can be started later in the morning if insulation is added to suspended ceiling (Modification No. 1). During the heating season, the existing system requires approximately four hours to bring the space temperature up to the design temperature. The space temperature can drop as low as 50 to 52°F at 5:00 A.M. Without new insulation, heat is escaping from the building envelope at almost the same rate at which it is being applied. With new insulation, the space temperature will only drop to approximately 62-64°F at 5:00 A.M. and will rise at a greater rate due to the improved thermal resistance of the envelope. During the heating season, the units can be started by 6:00-6:30 A.M., only if new insulation is added to the suspended ceiling. During the cooling season, the units can be started at 7:30-8:00 A.M., since there is seldom a cooling load during the morning hours.

Resetting the units' start-up time to 6:00 A.M. in the winter and 8:00 A.M. in the summer will save 157 MBTU/yr and 22,400 KWH/yr or $2950/yr, (FY 81), at an annual labor cost of 16 hours/yr and no capital investment.

3.5 MODIFICATION NO. 5 - RELOCATE MASTER THERMOSTATS

Some of the current air handling units supply air simultaneously to both interior and exterior spaces. To supplement the varying space heating loads, electric duct heaters with independent thermostat control are provided in the branches to the exterior spaces. The existing sequence of operation for the heating mode is as follows:

a. The master thermostat, which is located in the exterior zone, modulates the steam control valve in the air handling unit to maintain the exterior space at 68°F.

b. If the space temperature in the exterior zone falls below 66°F, the electric duct heater is energized to help satisfy the loads.

With the existing control concept, the supply air temperature to the interior zone is dictated by the losses in the exterior zone, resulting in overheated interior spaces. This deficiency can be remedied by relocating the master thermostat to an interior space and leaving the duct thermostat in the exterior space. Relocating the seven affected thermostats saves 10.5 MBTU/year at a capital investment of $560. The following AHU's are affected by this modification; AHU No. 1, 3, 4, 6, 7, 13, and 15.

TABLE 7

ECONOMIC ANALYSIS SUMMARY

Location: Cameron Station Energy Audit Bldg. No.3 FY 81

Project: Modification No. 5 - Thermostat Relocation

Economic Life 15 Yrs. Date Prepared 1/16/81 Prepared by D. Studley

COSTS

1.	Non-Recurring Initial Capital Costs:	
	a. CWE	$ 560
	b. Design	$
	c.	$
	d. Total	$ 560
	BENEFITS	
2.	Recurring Benefit/Cost Differential Other than Energy:	
	a. Annual Labor Decrease (+)/Increase (-)	$
	b. Annual Material Decrease (+)/Increase (-)	$
	c. Other Annual Decrease (+)/Increase (-)	$
	d. Total Costs	$
	e. 10% Discount Factor	$
	f. Discounted Recurring Cost (d x e)	$
3.	Recurring Energy Benefit/Costs:	
	a. Type of Fuel: No. 6 Fuel Oil	
	(1) Annual Energy Decrease (+)/Increase (-)	10.5 MBTU
	(2) Cost per MBTU	$ 8.53/MBTU
	(3) Annual Dollar Decrease/Increase ((1)x(2))	$ 90/Yr.
	(4) Differential Escalation Rate (8 %) Factor	13.112
	(5) Discounted Dollar Decrease/Increase (3)x(4)	$ 1174
	b. Type of Fuel:	
	(1) Annual Energy Decrease (+)/Increase (-)	
	(2) Cost per MBTU	$
	(3) Annual Dollar Decrease/Increase ((1)x(2))	$
	(4) Differential Escalation Rate (%) Factor	
	(5) Discounted Dollar Decrease/Increase ((3)x(4))	$
	c. Type of Fuel:	
	(1) Annual Energy Decrease (+)/Increase (-)	
	(2) Cost per MBTU	$
	(3) Annual Dollar Decrease/Increase ((1)x(2))	$
	(4) Differential Escalation Rate (%) Factor	
	(5) Discounted Dollar Decrease/Increase ((3)x(4))	$
	d. Discounted Energy Benefits (3a(5)+3b(5)+3c(5)+3d(5))	$ 1,174
4.	Total Benefits (Sum 2f+3d)	$ 1,174
5.	Discounted Benefit/Cost Ratio (Line 4/Line 1d)	2.1
6.	Total Annual Energy Savings (3a(1)+3b(1)+3c(1))	10.5 MBTU/Yr.
7.	E/C Ratio (Line 6 ÷ Line 1a/1000)	18.8
8.	Annual $ Savings (2d+3a(3)+3b(3)+3c(3))	$ 90/Yr.
9.	Pay-Back Period ((Line 1a - Salvage)+Line 8)	6.2 Yr.

4.0 BASIS FOR ANALYSIS

The following design and operating criteria has been used in the evaluation of the recommended energy conservation measures:

4.1 LOAD CALCULATIONS - Both computer analysis and hand calculations were used to determine the building heating and cooling loads. The results from both the "degree day method" and the computer simulation (DOE II) were compared to determine the possible energy savings available. Infiltration rates, U-Values and calculated procedures conform to the data presented in ASHRAE Handbook of Fundamentals.

Degree Days	4224/yr
Summer Design Temperature	$78^{o}F$
Winter Design Temperature	$68^{o}F$

4.2 ESCALATION AND INFLATION RATES - an inflation rate of 10 percent and escalation rates of 7 percent and 8 percent for electricity and fuel oil respectively, were used to determine the discounted benefit/cost ratios. The differential escalation rate factors are as follows:

Economic Life	Electricity (7%)	Fuel Oil (8%)
15 years	12.278	13.112
25 years	18.049	20.050

4.3 FUEL AND UTILITY COSTS

a. The most recent purchase of No. 6 fuel oil for Cameron Station was at a cost of $0.87 per gallon. The future price of fuel oil at the end of 1981 has been estimated to be $0.99/gallon. Assuming an average heating value of 153,000 BTU per gallon of fuel oil and an overall efficiency of 76 percent, results in a heating cost of $8.53 per million BTU's.

b. Cameron Station is currently procuring their electricity from the Virginia Electric and Power Company under the MS schedule. The rate

structure consists of a $6.22 per KW of demand charge and a 1.546¢ per KWH charge. For the analysis an average cost of 4.36¢ per KWH was used for fiscal year 1981. Cooling costs range from 0.9 KW to 1.0KW per ton of refrigeration for large centrifugal refrigeration gear, which results in a cost of $3.60 per million BTU's of cooling.

Actual total charges for electricity are, of course, based upon a combination of charges for usage (KWH) and demand (KWD). Since Cameron Station is metered as a unit, the applicable demand charge is determined by the peak loading for the entire base. The effect of peak reduction at Building No. 3 upon the peak of the base as a whole is indeterminate. Therefore, electricity charges used in this report have been determined utilizing average demand charges for the base as a whole.

MODIFICATION No. 1 APPENDIX A

CLIENT	CALC. No.
DOA	3395-M-01

SUBJECT
CAMERON STATION ENERGY AUDIT - BUILDING #3

PROBLEM:
- ANALYZE POSSIBLE ENERGY SAVINGS REALIZED BY INSULATING CEILING
- INVESTIGATE EFFECTS OF VARYING THICKNESS OF INSULATION.

CHECKER'S REMARKS:

APPROACH/ASSUMPTIONS:
- COMPARE RESULTS USING BOTH THE "DEGREE DAY" METHOD AND DOE-II COMPUTER OUTPUT.
- USE "BIN METHOD" FOR PLENUM HTG. REQUIREMENTS
- REMAINING ASSUMPTIONS PER CALC.

CHECKER'S REMARKS:

SOURCES-DATA/EQUATIONS:
- DOE II - COMPUTER PROGRAM
- ASHRAE SYSTEMS VOLUME '76 - ENERGY ESTIMATING

CHECKER'S REMARKS:

CONCLUSIONS:
- SEE GRAPH FOR ENERGY SAVINGS VS. INSULATION
- SEE ECONOMIC ANALYSIS SUMMARY FORMS FOR R-6, R-19, AND R-30 INSULATION.
- NOTE - BEST PAY-BACK FOR R-19 INSULATION (4.93 yrs)

CHECKER'S REMARKS:

CALCULATED BY	DATE
D. STOPLET	1/12/81
CHECKED BY Glenn A. Zelko	DATE 6-12-81

ED 501 (2/80)

MODIFICATION 1

NUS CORPORATION

Page 1 of 13

DATE 1/21/80

CLIENT DOA FILE NO. 5395 BY D. STUDLEY

SUBJECT CAMERON ST. ENERGY AUDIT BLDG #3 Checked By G.A. Lelko

ANALYSIS OF CEILING INSULATION

HOUR CALCS. DEGREE DAYS = 4224

$H_L = (56°F)(0.127)(130,000) = 924,560$ OCCUPIED (12 hours)

$H_L = \frac{(48°F)(0.127)(130,000)}{52} = \frac{792,480}{858,520}$ EVENINGS (12 hours)

$H_{L(TOTAL)} = \frac{858,520 \times 4224 \times 24 \text{ Hours}}{52°F} = 16773 \times 10^6$ MBTU/yr

ADD 2" INSULATION $U_{OVERALL} = 0.072$ (INCLUDES AIR SPACE & ROOF) (R-6 ADDED)

$H_L = 1673 \times 10^6 \times 0.072/0.127 = 948.9 \times 10^6$ MBTU/yr

SAVINGS = 724×10^6 MBTU/yr.

ADD 5" INSULATION $U_{OVERALL} = 0.05$ (INCLUDES AIR SPACE & ROOF) (R-15 ADDED)

$H_L = 1673 \times 10^6 \times 0.05/0.127 = 658.7 \times 10^6$ MBTU/yr

SAVINGS = 1014.3×10^6 MBTU/yr

ADD 9" INSULATION $U_{OVERALL} = 0.0275$ (R-30 ADDED)

$H_L = 1673 \times 10^6 \times 0.0275/0.127 = 362.3 \times 10^6$ MBTU/yr

SAVINGS = 1310.7×10^6 MBTU/yr.

NOTE - ADDING INSULATION TO THE CEILING COULD INCREASE THE HEATING REQUIRED IN THE PLENUM FOR FREEZE PROTECTION!

MODIFICATION 1

NUS CORPORATION

DATE

CLIENT DOA FILE NO. 5395 BY D. STUDLEY

SUBJECT CAHERON ST. ENERGY AUDIT #3 Checked By G.A. Celko

ANALYSIS OF CEILING INSULATION

COMPUTER MODEL .... UTILIZE "SUM" METHOD FOR HEATING MODE, "SZHR" FOR COOLING

BASELINE CONDITION ($U_{ROOF} = 0.127$, $U_{CEILING} = 0.204$)

HEATING LOAD	2203×10^6 MBTU/yr
COOLING LOAD	2176×10^6 MBTU/yr

ADD 2" INSULATION ($U_{ROOF} = 0.072$, $U_{CEILING} = 0.09$)

		SAVINGS
HEATING LOAD	1353×10^6 MBTU/yr	850×10^6 BTU/yr
COOLING LOAD	2095×10^6 MBTU/yr	81×10^6 BTU/yr
		931×10^6 BTU/yr

ADD 5" INSULATION ($U_{ROOF} = 0.05$, $U_{CEILING} = 0.06$)

		SAVINGS
HEATING LOAD	1038×10^6 MBTU/yr	1165×10^6 BTU/yr
COOLING LOAD	2057×10^6 MBTU/yr	119×10^6 BTU/yr
		1284×10^6 BTU/yr

ADD 9" INSULATION ($U_{ROOF} = 0.0275$, $U_{CEILING} = 0.03$)

HEATING LOAD	732×10^6 MBTU/yr	1471×10^6 BTU/yr
COOLING LOAD	2021×10^6 MBTU/yr	155×10^6 BTU/yr
		1626×10^6 BTU/yr

USING THE LOWEST VALUES BETWEEN HAND & COMPUTER*

	SAVINGS	
ADD 2" INSULATION	805×10^6 BTU/yr	USE VALUES
ADD 5" INSULATION	1133×10^6 BTU/yr	TO PLOT
ADD 9" INSULATION	1466×10^6 BTU/yr	GRAPH

*Hand values for heating + computer values for cooling

HTG. REQUIRED FOR PLENUM SPACE

DESIGN TEMP. 35°F
VOLUME 2,197,080 FT³
AREA = 130,000 SF.

HEAT GAIN TO PLENUM FROM CONDITIONED SPACE (EXISTING CONDITION)

U = 0.206
ΔT_1 = 68 − 35 = 33°F OCCUPIED
ΔT_2 = 64 − 35 = 29°F EVENINGS
Q = UAΔT = 0.206 × (33) × (130,000)
= **888,000 BTU/hr.** OCCUPIED
= 780,000 BTU/hr EVENINGS

HEAT LOSS THRU WALLS

WALL AREA = 34,500 S.F.

UA = 0.281 × (34,500) = **9790 BTUH/°F**

HEAT LOSS THRU ROOF

UA = 0.49 × (130,000) = **64,000 BTUH/°F**

HEAT GAIN TO PLENUM FROM EQUIPMENT

- STEAM PIPING - ASSUME ± 1500 LINEAR FT
  ΔT 75 BTUH/FT OF PIPE (95°F SURF.)
  H_G = 75 × 1500 = **112,500 BTUH**
- CONDENSATE PIPING - ASSUME 1500 FT @ 75 BTUH/FT
  H_G = **112,500 BTUH**
- DUCT LEAKAGE — 5% OF 137,000 CFM = 6850 CFM
  H_G = 6850 × 1.08 × 40°F = **296,000 BTUH**

NUS CORPORATION

DATE 1/21/81

CLIENT DoA FILE NO. 5395 BY D. STOOLEY

SUBJECT CAMERON STATION ENERGY AUDIT BLDG 3 Checked By G.A. Lelko

HEATING REQUIRED TO PLENUM "BIN METHOD"

OUTSIDE TEMP	HEAT LOSS THRU WALLS & ROOF		HOURS OF OCCURANCE	TOTAL YEARLY LOAD	
32 °F	221,460	BTUh	542	120×10^6	BTU
27 °F	590,560	BTUh	254	150×10^6	BTU
22 °F	959,660	BTUh	138	132×10^6	BTU
17 °F	1,328,760	BTUh	54	71×10^6	BTU
12 °F	1,698,000	BTUh	17	29×10^6	BTU
7 °F	2,066,960	BTUh	2	4×10^6	BTU
			1007	506×10^6 BTU	

+10% S.F. = 60×10^6 BTU ⇒ 570×10^6 BTU

ASSUME HEAT GAINS FROM SPACE CONCURRENT WITH 40% OF THE ABOVE HOURS.

TOTAL HOURS = $1007 \times 0.40 =$ 403 HOURS

HEAT GAIN / HOUR = 1,409,000 BTU / HR.

$H_q = 569 \times 10^6$ BTU

NET HEATING = 0

ADD 8" INSULATION TO CEILING $U = 0.09$

$H_q = 888,000 \times \frac{0.09}{0.206} = 384,300$ BTUh OR 504,000 BTUh (LESS)

$H_{q(\text{EVENINGS})} = 780,000 \times (1007 - 403) \times \frac{0.09}{0.206} = 206 \times 10^6$ BTU/yr

$H_q/yr = (1409,000 - 504,000)(403) + 206 \times 10^6$ BTU/yr $= 570 \times 10^6$ BTU/yr

NET HEATING = 0

ADD 9" INSULATION TO CEILING

$H_q = 888,000 \times \frac{0.06}{0.206} = 257,000$ OR 691,000 BTU/h LESS

$H_{q(\text{EVENINGS})} = 780,000 \times \frac{0.06}{0.206} (604) = 137 \times 10^6$ BTU/yr

$H_q/yr = (1409,000 - 691,000)403 + 137 \times 10^6 = 450.5 \times 10^6$ BTU/yr

NET HEATING = 118.5×10^6 BTU/yr

NUS CORPORATION

DATE 1/21/81

CLIENT DOA FILE NO. 5595 BY D. STODLEY

SUBJECT CAMERON ST. ENERGY AUDIT BUILDING #3 Checked By G.A. Leiko

REQUIRED HEATING TO PLENUM

ADD 9" OF INSULATION

$H_{L_1} = 888{,}000 \times \frac{0.03}{0.206} = 129{,}000$ BTU/hr or 759,000 BTU/hr LESS

$H_{L_1(\text{EVENINGS})} = 780{,}000 \times \frac{0.03}{0.206} \times (604) = 69.6 \times 10^6$ BTU/yr

$H_{L_1(\text{TOTAL})} = (1409000 - 789000)(403) + 69.6 \times 10^6 = 262 \times 10^6$ BTU/yr

NET HEATING = 307×10^6 BTU/yr

ADD 7" OF INSULATION ($U_{\text{ceiling}} = 0.04$)

$H_{L_1} = 888{,}000 \times \frac{0.04}{0.206} = 172{,}000$ BTU/hr or 716,000 Btu/h LESS

$H_{L_1(\text{EVENINGS})} = 780{,}000 \times \frac{0.04}{0.206} \times 604 = 91.5 \times 10^6$ BTU/yr

$H_{L_1(\text{TOTAL})} = (1409{,}000 - 716{,}000) \times 403 + 91.5 \times 10^6 = 279 \times 10^6$ BTU/yr

NET HEATING = 289×10^6 BTU/yr.

ADD ≈ 6" OF INSULATION ($U_{\text{ceiling}} = 0.05$)

$H_{L_1} = 888{,}000 \times \frac{0.05}{0.206} = 216{,}000$ BTU/h OR 672,000 BTU/h LESS

$H_{L_1(\text{EVENINGS})} = 780{,}000 \times \frac{0.05}{0.206} \times 604 = 114 \times 10^6$ BTU/yr

$H_{L_1(\text{TOTAL})} = (1409 - 672) \times 1000\ (403) + 114 \times 10^6$ BTU/yr $= 297 \times 10^6$ BTU/h

NET HEATING = 271×10^6 BTU/yr.

REQUIRED HEATING TO PLENUM

A SUMMARIZED EQUATION

NET HEAT GAIN TO PLENUM = $H_{q(P)}$

$$H_{q(P)} = 570\times10^{6} - \left[\left[1.409\times10^{6} - .888\times10^{6}\right]\times 403 - \left[.888\times10^{6}\times\frac{U_o}{0.206}\times 403\right] + \left[.780\times10^{6}\times\frac{U_o}{0.206}\times 604\right]\right]$$

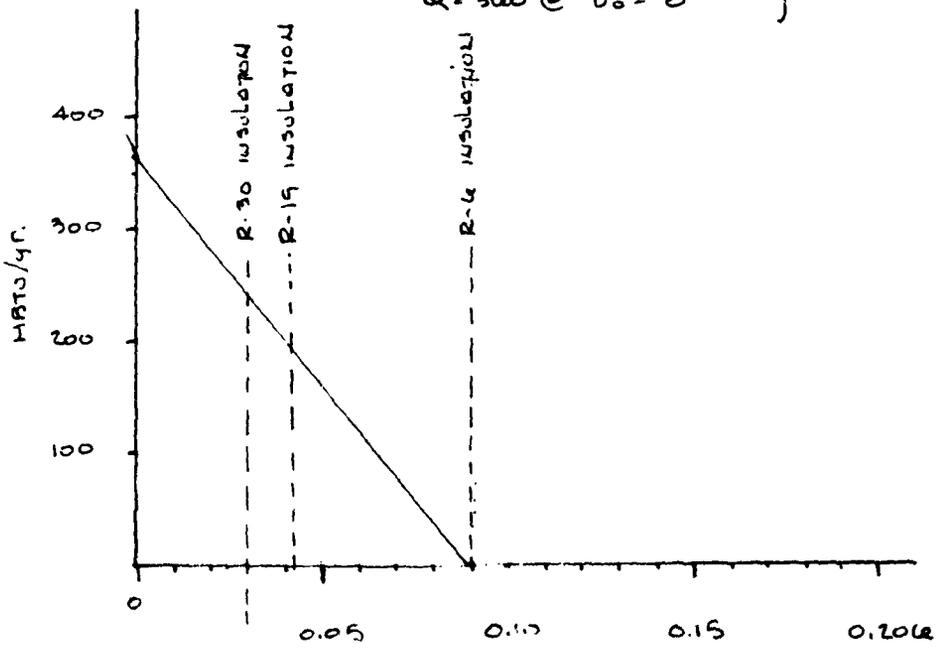
$$= \left[570 - 209\right]\times10^{6} + \left[-4024\times10^{6}\times U_o\right]$$

$$= 360\times10^{6} - 4024\times10^{6} U_o$$

USE EQ. to Plot graph

$Q = 0$ @ $U_o = 0.089$

$Q = 360$ @ $U_o = 0$



COST ESTIMATE

ACTIVITY AND LOCATION: CAMERON STATION ENERGY AUDIT

NUS CORPORATION

Pg. 7 of 13

1 | 21 | 81

PROJECT TITLE: MODIFICATION 1 - ALTERN. B - 6" INSULATION

STATUS OF DESIGN: ☐ PIR ☐ 30% ☐ 100% ☐ FINAL ☐ Other (Specify) _____

D. STUDLEY

ITEM DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	MATERIAL COST UNIT COST	MATERIAL COST TOTAL	LABOR COST UNIT COST	LABOR COST TOTAL	ENGINEERING ESTIMATE UNIT COST	ENGINEERING ESTIMATE TOTAL
• PER VENDOR CONTACTS - TOTAL								
COST, INCLUDING OVERHEAD &								
FEES = $42,900								
Bare Costs:								
Contingency:								
Overhead + Profits:								
Subtotal:								42900
Escalation: INFLATION TO END OF FY81								45,900
Construction Budget								
Design Fee: 6%								

A-3

COST ESTIMATE

ACTIVITY AND LOCATION: CAMERON ST. ENERGY AUDIT BLDG 3

NUS CORPORATION

Pg 8 of 13

1/21/81

PROJECT TITLE: MODIFICATION 1. ALT. "A" - 9" INSULATION

STATUS OF DESIGN: ☐ P.I.D. ☐ 30% ☐ 100% ☐ FINAL ☐ Other (Specify) _____

D. STUDLEY

ITEM DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	MATERIAL COST UNIT COST	MATERIAL COST TOTAL	LABOR COST UNIT COST	LABOR COST TOTAL	ENGINEERING ESTIMATE UNIT COST	ENGINEERING ESTIMATE TOTAL
• PER VENDOR CONTACTS, TOTAL								
COST INCLUDING OVERHEAD &								
PROFIT = $67,600								
Bare Costs:								
Contingency:								
Overhead + Profits:								
Subtotal:								$67,600
Escalation: 7% TO END OF FY81								$ 72,300
Construction Budget								
Design Fee: 6%								+ 4,338
								$76,638

A-9

COST ESTIMATE

ACTIVITY AND LOCATION: CAMERON ST. ENERGY AUDIT BLDG. No. 3

PROJECT TITLE: MODIFICATION 1. ALT. "C" 3" OF INSULATION

NUS CORPORATION

STATUS OF DESIGN: ☐ PID ☐ 30% ☐ 100% ☐ FINAL ☐ Other (Specify) _____

9 of 13

1/21/81

D. STUDLEY

ITEM DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	MATERIAL COST UNIT COST	MATERIAL COST TOTAL	LABOR COST UNIT COST	LABOR COST TOTAL	ENGINEERING ESTIMATE UNIT COST	ENGINEERING ESTIMATE TOTAL
• PER VENDOR CONTRACTS, TOTAL								
COST, INCLUDING OVERHEAD &								
PROFIT ≅ $36,000								
Bare Costs:								
Contingency:								
Overhead + Profits:								
Subtotal:								$36,000
Escalation: 7% TO END OF FY 81								+ $2,520
Construction Budget								
Design Fee: 6%								$2,311
								$40,831

A-10

NUS CORPORATION

REPORT OF VISIT

DATE Jan. 6, 1981

TIME

COMPANY Potomac Insulating Contractors

ADDRESS 6310-D Gravel Ave.
Alexandria, VA.

VENDOR REPR SOLICITATION

NUS VISITATION

X PHONE 971-9334 (703)

VENDOR REPR & TITLE

REPR & TITLE

NAME OF EQUIPMENT R-19 - 6" "Faced" Insulation
R-30 - 9" "Faced" Insulation

CATALOG NO MODEL NO

DESCRIPTION SIZE, DIAMETER, HEIGHT, WEIGHT, OVERALL DIMENSIONS, FLOOR SPACE REQUIRED, NUMBER OF MAJOR DRIVERS AND HORSEPOWER, LEGS, PAD, OTHER

SPECIAL CONDITIONS – REGULATORY, LOCAL CODES AND OTHER PROJECT UNIQUE REQUIREMENTS

ESTIMATED COST OR QUOTE

VENDOR DELIVERY TIME

SOURCE INSPECTION REQUIRED

ITEM NO. ON EQUIPMENT LIST

PLOT PLAN FLOW CHARTS

OTHER – CATALOGUE AND VENDOR DESIGN DATA

MATTERS DISCUSSED NUS Requested Prices for Installing 130,000 S.F. of Insulation over Suspended Ceilings

Prices include O & P, Installed.

6" "Faced" Batt @ $.30/S.F. Installed ≅ $39,000.00

9" "Faced" Batt @ $0.47/S.F. " ≅ $61,100.00

3½" "Faced" Batt @ $0.28/S.F. ≅ $36,400.00

NUS PERSONNEL INVOLVED

PROJECT No 5995

BY D. Shubley

DISTRIBUTE TO

PURCHASING

ESTIMATING

NUS CORPORATION

REPORT OF VENDOR CONTACT

DATE Jan 5th 1981

TIME

COMPANY NAME Baltimore Home Insulators

ADDRESS 6149 Washington Blvd.
Elkridge

VENDOR REPR SOLICITATION

NUS VISITATION

X PHONE 621-2780

REPR & TITLE Larry Guren

REPR & TITLE

NAME OF EQUIPMENT R-19 (6") Batt Insulation

CATALOG NO MODEL NO

DESCRIPTION SIZE, DIAMETER, HEIGHT, WEIGHT, OVERALL DIMENSIONS, FLOOR SPACE REQUIRED
NUMBER OF MAJOR DRIVERS AND HORSEPOWER, LEGS, PAD, OTHER

SPECIAL CONDITIONS - REGULATORY, LOCAL CODES AND OTHER PROJECT UNIQUE REQUIREMENTS

ESTIMATED COST OR QUOTE

VENDOR DELIVERY TIME

SOURCE INSPECTION REQUIRED

ITEM NO ON EQUIPMENT LIST

PLOT PLAN FLOW CHARTS

OTHER CATALOGUE AND VENDOR DESIGN DATA

MATTERS DISCUSSED Has Requested a Price For Installing 130,000 S.F. of Insulation Over Suspended Ceiling
R-19 Insulation - "Faced"
Total Installed Cost of ~~ZB~~ 29½ ¢ /S.F.

NUS PERSONNEL INVOLVED

PROJECT No 5395

BY D. Stanley

DISTRIBUTE TO

PURCHASING

ESTIMATING

NUS CORPORATION

REPORT OF VENDOR CONTACT

DAT Jan 5th 1981
TIME 3:00 P.M

( ) VENDOR REPR SOLICITATION
( ) NUS VISITATION
(X) PHONE 937-5700

COMPANY NAME Welden Cambell Co. Inc.
ADDRESS 10721 Tucker St.
Beltsville, MD.
REPR & TITLE George Johnson
REPR. & TITLE

NAME OF EQUIPMENT Certain-Teed Insulation
6" Foil-Backed R-19 Insulation

CATALOG NO. MODEL NO.

DESCRIPTION SIZE, DIAMETER, HEIGHT, WEIGHT, OVERALL DIMENSIONS, FLOOR SPACE REQUIRED, NUMBER OF MAJOR DRIVERS AND HORSEPOWER, LEGS, PAD, OTHER.

SPECIAL CONDITIONS - REGULATORY, LOCAL CODES AND OTHER PROJECT UNIQUE REQUIREMENTS.

ESTIMATED COST OR QUOTE

VENDOR DELIVERY TIME

SOURCE INSPECTION REQUIRED

ITEM NO. ON EQUIPMENT LIST

PLOT PLAN FLOW CHARTS

OTHER - CATALOGUE AND VENDOR DESIGN DATA.

MATTERS DISCUSSED

- Budget Price For 6" Foil Backed Insulation (Mat'l Only)
$224/1000 S.F.
Price Holds up until August - 6% increase

NUS PERSONNEL INVOLVED

PROJECT No 5395

BY D. Studley

DISTRIBUTE TO
PURCHASING
ESTIMATING

NUS CORPORATION

REPORT OF VENDOR CONTACT

DATE JAN 5th, 1981
TIME 11:30 AM.

VENDOR REPR SOLICITATION
NUS VISITATION
X PHONE 937-4710

COMPANY NAME AC & R INSULATION CO.
ADDRESS 10310 SOUTHARD DR.
BELTSVILLE MD.
REPR & TITLE Ed ROGERS
REPR & TITLE

NAME OF EQUIPMENT CEILING INSULATION
R-19 (6") & R-30 (9")

CATALOG NO MODEL NO

DESCRIPTION SIZE, DIAMETER, HEIGHT, WEIGHT, OVERALL DIMENSIONS, FLOOR SPACE REQUIRED
NUMBER OF MAJOR DRIVERS AND HORSEPOWER, LEGS, PAD, OTHER
CAMERON STATION, BLDG. 3,
HEIGHT OF PLENUM SPACE ≥ 8'-0"
AREA OF CEILING = 129,000 S.F.

SPECIAL CONDITIONS – REGULATORY, LOCAL CODES AND OTHER PROJECT UNIQUE REQUIREMENTS

ESTIMATED COST OR QUOTE
VENDOR DELIVERY TIME
SOURCE INSPECTION REQUIRED
ITEM NO ON EQUIPMENT LIST
PLOT PLAN FLOW CHARTS

OTHER – CATALOGUE AND VENDOR DESIGN DATA.

MATTERS DISCUSSED NUS REQUESTED A PRICE FOR INSTALLING INSULATION IN THE CAMERON STATION BLDG. #3 CEILING.
THICKNESS OF INSULATION A) 6"
B) 9"
AREA OF INSULATION 129,000 S.F.

TOTAL PRICE INCLUDING MATERIAL AND INSTALLATION & PROFIT, ETC.

(A). 42¢/S.F. FOR R-19 (COMPLETE)
B). 57¢/S.F FOR R-30 (")

NUS PERSONNEL INVOLVED
PROJECT NO. 5395
BY I. STODLE

DISTRIBUTE TO
PURCHASING
ESTIMATING

ED-813 (8/76)

MODIFICATION NO. 2.

CLIENT	CALC. No.
DOA	5395-M-02

SUBJECT
CAMERON ST. ENERGY AUDIT BUILDING No. 3

PROBLEM:
ANALYSE POSSIBLE ENERGY SAVINGS BY RESTORING ECONOMIZER CYCLE CONTROLS. ALSO ANALYSE POSSIBLE ENERGY SAVING REALIZED BY REDUCING VENTILATION RATES.

CHECKER'S REMARKS:

APPROACH/ASSUMPTIONS:
PER CALCULATION

CHECKER'S REMARKS:

SOURCES-DATA/EQUATIONS:
DOE-II - COMPUTER PROGRAM
ASHRAE STD 62-73
ASHRAE HB. OF FUND.

CHECKER'S REMARKS:

CONCLUSIONS:
RESTORING ECONOMIZER CONTROLS = 247×10^6 BTU/yr
REDUCING VENTILATION RATES = 983×10^6 BTU/yr.
TOTAL SAVINGS ($) = $8176/YEAR
PAYBACK PERIOD = 4.04 YEARS
FOR FURTHER ECON. ANALYSIS INFO. SEE ECIP FORM.

CHECKER'S REMARKS:

CALCULATED BY	DATE
D. STUDLEY	1/12/81
CHECKED BY	DATE
J. A. Zelko	6-12-81

ED 501 (2/80)

RE-ADJUST & RESTORE ECONOMIZER CYCLE

DURING THE FIELD SURVEY, IT WAS OBSERVED THAT A LARGE NO. OF THE ECONOMIZER CYCLES WERE INOPERATIVE FOR THE FOLLOWING REASONS;

(A.). TEMPERATURE CONTROLS VASTLY OUT OF COLLBRATION (VERIFIED BY TEMPERATURE INDICATORS)

(B). DAMPER OPERATORS ARE INOPERATIVE (VERIFIED by VARYING MANUAL OVERRIDE)

THE UNITS WHICH CONTAIN FAULTY DAMPER OPERATORS ARE AS FOLLOWS;

(1) AHU NO. 20
(2) AHU NO. 11
(3) AHU NO. 10
(4) AHU NO. 19
(5) AHU NO. 18

} $\cong$ 22.7% OF THE UNITS DAMPERS ARE INOPERATIVE

THE TEMPERATURE INDICATORS DEVIATED FROM ACTUAL TEMPERATURES (O.A) ON THE AVERAGE FROM 20% - 30%. THE INDICATED TEMPERATURES USUALLY INDICATED AN O.A. TEMP. GREATER THAN THE ACTUAL. THIS MEANS THAT THE ECONOMIZERS ARE NOT TAKING ADVANTAGE OF THE LOWER ENTHALPY AVAILABLE IN THE O.A, AND ADMITTING HIGH ENTHALPY AIR ERRONEOUSLY.

- ASSUME CONSERVATIVELY THAT THE ECONOMIZERS ARE NOT TAKING ADVANTAGE OF 20% OF THE FREE COOLING AVAILABLE.

COMBINED EFFECT (INOPERATIVE DAMPERS & MISCOLIBRATION)

$$\% \text{ LOST} = \left(1 - \frac{17 \text{ UNITS OPERATING @ 80\% EFFECTIVENESS}}{22 \text{ UNITS TOTAL}}\right) = \boxed{38\%}$$

RE-ADJUST & RESTORE ECONOMIZER CYCLE

TOTAL FREE COOLING AVAILABLE.
(USING DOE II COMPUTER MODEL)

BASELINE RUN W/O ECONOMIZER = 1200.9×10^6 BTU/yr cooling
(USING THE "SUN" SYSTEM)

BASELINE RUN W/ ECONOMIZER = 551.8×10^6 BTU/yr cooling

YEARLY FREE CLG = 649×10^6 BTU/yr

YEARLY SAVINGS FOR RESTORING ECONOMIZER
$= (0.38)(649 \times 10^6) = 247 \times 10^6$ BTU/yr.

RE-ADJUSTMENT OF THE ECONOMIZER CYCLE CAN ALSO BE UTILIZED TO REBALANCE THE OUTDOOR AIR VENTILATION RATE

(USING DOE II)

OBJECTIVE - DETERMINE THE COST/CFM/yr OF OUTDOOR AIR

BASE RUN - USE INFILTRATION AS O.A. AND ANALYSE INCREASE IN YEARLY LOAD WHEN INFILTRATION RATE DURING OCCUPIED TIMES IS VARIED

INFILTRATION = 0.162 CFM/S.F. DURING 5:00 AM - 5:00 PM
INFILTRATION = 0.037 CFM/S.F. DURING 5:00 PM - 5:00 AM

BASE RUN LOADS → $1,200.9 \times 10^6$ BTU (CLG), 220.3×10^6 BTU (HEATING)

NUS CORPORATION

DATE 1/21/81

CLIENT DOA FILE NO. 5395 BY D. STUDLEY

SUBJECT CAMERON STATION ENERGY AUDIT Checked By G.A. Velko

BUILDING #3

RE-ADJUST & RESTORE ECONOMIZER

REBALANCE VENTILATION RATE

BASE RUN w/ 0.037 CFM INFILTRATION CONTINUOUS

LOADS — 1192.9×10^6 BTU (COOLING) 1348.9×10^6 BTU (HEATING)

DIFFERENCE = 8×10^6 BTU (COOLING) 854.8×10^6 BTU (HEATING)

TOTAL CFM (DIFFERENCE) = 0.162 - 0.037 = 0.125 CFM/°F
= 0.125 × 190,000 = 16,250 CFM

COST /CFM = 862.8×10^6 BTU/yr (SAVED) / 16,250 CFM
= 53095 BTU/CFM (VELITILE)

ESTIMATE OF THE QUANTITY OF VENTILATION AIR CU[illegible] BEING INTRODUCED

- FROM THE FEILD SURVEY THE AVE. O.A. TEMP FROM INDICATORS = 45.6
- AVERAGE MIXED AIR TEMP. FROM INDICATORS = 54.3
- ACTUAL O.A. TEMP = 35°F

ASSUME BOTH INDICATORS DEVIATE CONSISTANTLY
∴ CORRECTED M.A. TEMP. = 64.3°F

$35x + 70(1-x) = 64.3$

$x = 16\%$ O.A.

USE 20% O.A. FOR EXISTING CONDITIONS
TOTAL SUPPLY AIR = 137,960 CFM
O.A = 27,512 CFM

READJUST & RESTORE ECONOMIZER CYCLE

REBALANCE VENTILATION RATE

LOAD/YEAR FOR EXISTING CONDITION
= 27,512 CFM × 53095 BTU/CFM
= 1461 × 10^6 BTU/YR.

LOAD/YEAR FOR DESIGN CONDITION
= 16,210 × 53095 BTU/YR.
= 861 × 10^6 BTU/YR.

SAVINGS REALIZED BY RETURNING OUTDOOR AIR TO DESIGN CONDITIONS
= **600 × 10^6 BTU/YR.**

MINIMUM REQUIRED AMOUNT OF VENTILATION USING ASHRAE 62-73

= 15 CFM/PERSON FOR OFFICE SPACE
= 15 CFM × 600 PEOPLE = 9000 CFM

LOAD/YEAR FOR 9000 CFM
= 478 × 10^6 BTU/YR.

SAVINGS REALIZED BY ADJUSTING O.A. QUANTITIES TO ASHRAE REQUIREMENTS

= 383 × 10^6 BTU/YR

TOTAL SAVINGS = **983 × 10^6 BTU/YR**

COST ESTIMATE

ACTIVITY AND LOCATION: CAMERON STATION ENERGY AUDIT BUILDING NO. 3

NUS CORPORATION

5 of 7

1/21/81

PROJECT TITLE: MODIFICATION NO. 2 - CALIBRATE AND REPLACE ECONOMIZER CONTROLS & REDUCE VENT. RATES

STATUS OF DESIGN: ☐ PID ☐ 30% ☐ 100% ☐ FINAL ☐ Other (Specify) _____

D. STOOLEY

ITEM DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	MATERIAL COST UNIT COST	MATERIAL COST TOTAL	LABOR COST UNIT COST	LABOR COST TOTAL	ENGINEERING ESTIMATE UNIT COST	ENGINEERING ESTIMATE TOTAL
• PER VENDOR CONTACTS, TOTAL COST								
TO REPLACE ALL CONTROLS (100%)								
@ $1500 /UNIT (INCLUDING O & P)								
• TO REDUCE VENT. RATES, LINKAGE								
HAS TO BE VARIED (CAN BE INCLUDED								
IN THE ABOVE $1500)								
TOTAL COST = $1500 x 22 = $33000								
Bare Costs:								
Contingency:								
Overhead + Profits:								
Subtotal:								$33,000
Escalation: 0% - PRICES FOR FY 81								
Construction Budget								
Design Fee: 6%								+ $1980
								$34,980

NUS CORPORATION

REPORT OF VENDOR CONTACT

DATE 1/12/81

TIME

VENDOR REPR SOLICITATION

NUS VISITATION

PHONE 703-827-3010

COMPANY NAME HONEYWELL, INC.

ADDRESS 1776 OLD MEADOW LN.
MCLEAN, VA. 22012

REPR & TITLE PAUL LUOMOA

REPR & TITLE

NAME OF EQUIPMENT ECONOMIZER CONTROLS -

CATALOG NO MODEL NO

DESCRIPTION SIZE, DIAMETER, HEIGHT, WEIGHT, OVERALL DIMENSIONS, FLOOR SPACE REQUIRED, NUMBER OF MAJOR DRIVERS AND HORSEPOWER, LEGS, PAD, OTHER

SPECIAL CONDITIONS - REGULATORY, LOCAL CODES AND OTHER PROJECT UNIQUE REQUIREMENTS

ESTIMATED COST OR QUOTE

VENDOR DELIVERY TIME

SOURCE INSPECTION REQUIRED

ITEM NO. ON EQUIPMENT LIST

PLOT PLAN FLOW CHARTS

OTHER CATALOGUE AND VENDOR DESIGN DATA

MATTERS DISCUSSED NUS REQUESTED BUDGET PRICES FOR REPLACING AND EXISTING ECONOMIZER SYSTEM. REQ. REPLACEMENT = 1 operator, 2 CONTROLLERS, AND BULBS ≈ $100/device OR $500/UNIT

+ 200 - 300% FOR INSTALLATION, O&P, etc.

Total cost FOR complete REPLACEMENT/UNIT ≈ $1000 - $1500 (END OF BL)

$250 GOOD IF NOT ALL EQUIP HAS TO BE REPLACED (CALIBRATED)

NUS PERSONNEL INVOLVED

PROJECT NO. 5395

BY D. STUDLEY

DISTRIBUTE TO:

PURCHASING

ESTIMATING

NUS CORPORATION

REPORT OF VENDOR CONTACT

DATE 1/12/81

TIME

VENDOR REPR SOLICITATION

NUS VISITATION

PHONE 703-750-3250

COMPANY NAME JOHNSON CONTROLS

ADDRESS 3740 GENERAL WASHINGTON DRIVE
ALEXANDRIA, VA 22313

REPR & TITLE R. BULLOCK, MGR. SALES

REPR & TITLE

NAME OF EQUIPMENT ECONOMIZER CONTROLS

CATALOG NO MODEL NO

DESCRIPTION SIZE, DIAMETER, HEIGHT, WEIGHT, OVERALL DIMENSIONS, FLOOR SPACE REQUIRED, NUMBER OF MAJOR DRIVERS AND HORSEPOWER, LEGS, PAD, OTHER

SPECIAL CONDITIONS REGULATORY, LOCAL CODES AND OTHER PROJECT UNIQUE REQUIREMENTS

ESTIMATED COST OR QUOTE

VENDOR DELIVERY TIME

SOURCE INSPECTION REQUIRED

ITEM NO ON EQUIPMENT LIST

PLOT PLAN FLOW CHARTS

OTHER CATALOGUE AND VENDOR DESIGN DATA

MATTERS DISCUSSED NOS REQUESTED BUDGET PRICES FOR REPLACING ECONOMIZER CONTROLS ON AN EXISTING SYSTEM
≈ $500 /UNIT MATERIAL (END OF SI)
≈ $1000 TO ≈ $1500 /UNIT TOTAL COSTS

COST FOR PNEUMATIC TUBING RELOCATION ≈ $1.50 TO $2.00 / LIN FT FOR RETROFIT WORK

NUS PERSONNEL INVOLVED

PROJECT NO. 5395

BY D. STUPLEY

DISTRIBUTE TO:
PURCHASING
ESTIMATING

ED-813 (8/76)

MODIFICATION NO. 3

CLIENT	CALC. No.
DOA	5395-M-03
SUBJECT: CAMERON ST. ENERGY AUDIT BUILDING NO. 3	

PROBLEM:

ANALYZE POSSIBLE ENERGY SAVINGS REALIZED BY ADDING CLOSURE DAMPER TO OUTDOOR-AIR INTAKE & BY ADDING CONTROLS TO CLOSE STEAM COIL ON UNIT SHUT-DOWN

CHECKER'S REMARKS:

APPROACH/ASSUMPTIONS:

(1). ASSUME THERMAL STACK INCREASES ΔP ACCROSS BUILDING WALLS ENOUGH TO INCREASE FLOW RATE BY 50% WHEN COIL IS HOT & 20% WHEN COIL IS COLD.

CHECKER'S REMARKS:

SOURCES-DATA/EQUATIONS:

ASHRAE HB of FUND. 72 - INFILTRATION DATA ch. 19.

CHECKER'S REMARKS:

CONCLUSIONS:

TOTAL AMOUNT OF ENERGY WASTED THRU DEFICIENCY ≈ 230 MBTU/yr.

E/C RATIO = 19.4

PAY-BACK PERIOD = 6.00 yr.

CHECKER'S REMARKS:

CALCULATED BY	DATE
D. STUDLEY	1/21/81
CHECKED BY: G.A. LEIKO	DATE: 6-12-81

ED-501 (2/80)

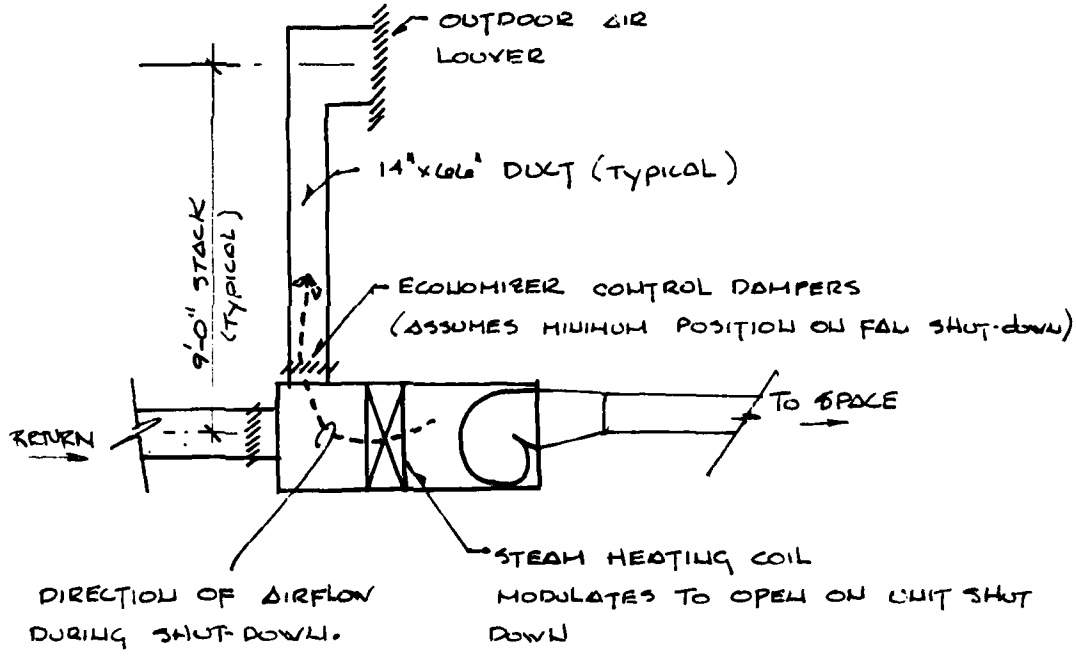
NUS CORPORATION

DATE 1/21/81

CLIENT DOA FILE NO. 5395 BY D. STUDLEY

SUBJECT CAMERON ST. ENERGY AUDIT. BLDG. #3 Checked By C.A. Velko

MODIFICATION - ADD CLOSURE DAMPER TO OUTDOOR AIR INTAKE & ADD CONTROLS TO CLOSE STEAM VALVE ON UNIT SHUT-DOWN



TOTAL AREA OF O.A. DUCTS -

$A = (24\times30)\times2 + (14\times66)\times9 + (28\times30) + (24\times40) + (25\times72) + (20\times56)\times2 + (68\times20) + (36\times30)$

$A = 18{,}036$ SQ. IN.

AVE. HEIGHT OF STACK = 9'-0"

ADD CLOSURE DAMPER

HEAT LOSS OUT O.A. INTAKE WHILE HEATING COIL IS OPEN

$Q = 9.4(A)(\sqrt{h(T_i - t_o)})$ ASHRAE H.B. of FUND. 72

$t_i - t_o = 180°F - 70°F = 110°F$

$A = 18,036 / 144 = 125.25$ s.f.

$h = 9$ ft.

REDUCE Q DUE TO POOR EFFECTIVENESS OF OPG. (50%)

$Q = 1.2(A)(\sqrt{h(t_i - t_o)})$

(use this value due to unfavorable conditions)

$Q = 28,375$ CFM — FLOW RATE TOO HIGH.

— ASSUME FLOW RATE = 150% OF INFILTRATION

OR $Q = 1.5 \times 4785 = 7180$ CFH.

HEAT LOSS $= 1.08 \times 7180 \times 110°F =$ **859,000 BTUH**

[HOURS OF OPERATION, IN WHICH STEAM COIL IS OPEN AND UNIT IS SHUT DOWN.]

STEAM SYSTEM TYPICALLY OPERATES FROM 2-3 AM TO 2-3 PM. UNIT OPERATES 5:00 AM - 5:00 PM

∴ HRS. OF OPER. = 2 hr/day × 5 day/wk × 20 wk./yr

= 200 Hours/yr

YEARLY ENERGY LOST = $200 \times 859000 =$ **171×10^6 BTU**

FROM STEAM COIL

STACK EFFECT ALSO INCREASES INFILTRATION DUE TO THE DIRECT ROUTE, EVEN WHEN COIL IS COLD

ASSUME 20% INCREASE IN INFILTRATION

HEAT LOSS $= 1.08(4785 \times 0.2)(25°F) = 25,840$ BTUH

@ 108 Hours/wk & 20 wks/year = **59×10^6 BTU/yr**

TOTAL = 230×10^6 BTU/yr HTG.

NUS CORPORATION

REPORT OF VENDOR CONTACT

DATE 1/8/80
TIME
VENDOR REPR SOLICITATION
NUS VISITATION
PHONE 301-772-2992

COMPANY NAME ALEXANDER MACLEOD
ADDRESS 4118 LEE HIGHWAY
ARLINGTON VA. 22207
REPR & TITLE A. MACLEOD
REPR & TITLE

NAME OF EQUIPMENT SHUT OFF DAMPERS 16" x 66" OR 14" x 60" WITH ELECTRIC OPERATORS
CATALOG NO MODEL NO
DESCRIPTION SIZE, DIAMETER, HEIGHT, WEIGHT, OVERALL DIMENSIONS, FLOOR SPACE REQUIRED, NUMBER OF MAJOR DRIVERS AND HORSEPOWER, LEGS, PAD, OTHER

SPECIAL CONDITIONS REGULATORY, LOCAL CODES AND OTHER PROJECT UNIQUE REQUIREMENTS

ESTIMATED COST OR QUOTE
VENDOR DELIVERY TIME
SOURCE INSPECTION REQUIRED
ITEM NO ON EQUIPMENT LIST
PLOT PLAN FLOW CHARTS

OTHER CATALOGUE AND VENDOR DESIGN DATA

MATTERS DISCUSSED NUS REQUESTED BUDGET PRICES FOR 22 DAMPERS WITH OPERATORS.
UNIT PRICE = $167.00 EA.
TOTAL PRICE = $3677.00
UNIT PRICE FOR FIBI = +8% = $180.00

NUS PERSONNEL INVOLVED
PROJECT NO 3395
BY D. STUDLEY

DISTRIBUTE TO
PURCHASING
ESTIMATING

ED 813 (8/79)

COST ESTIMATE

ACTIVITY AND LOCATION: CAMERON ST. ENERGY AUDIT BLDG. #3

NUS CORPORATION

4 of 4

1/21/81

PROJECT TITLE: ADD CLOSURE DAMPER & MODIFICATION 3- CONTROLS TO CLOSE STEAM VALVE

STATUS OF DESIGN: ☐ PID ☐ 30% ☐ 100% ☐ FINAL ☐ Other (Specify) _____

D. STUDLEY

ITEM DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	MATERIAL COST UNIT COST	MATERIAL COST TOTAL	LABOR COST UNIT COST	LABOR COST TOTAL	ENGINEERING ESTIMATE UNIT COST	ENGINEERING ESTIMATE TOTAL
(1). SHUT-OFF DAMPER (PER CONTACTS)	22		180	3960	*	840 *		4800
*LABOR = 1 SHEET METAL 1 APPRENTICE AT $220/day (OUTPUT = 7/day) No. of DAYS = 4								
(2) SOLENOID VALVE	22		75	1650	75	1650		3300
Bare Costs:								$8100
Contingency: 10%								+ $810
Overhead + Profits: 35%								+ $2840
Subtotal:								$11,750
Escalation: 0% - END OF 81 PRICES								
Construction Budget								
Design Fee: 6%								$710
								$12,460

MODIFICATION No. 4

CLIENT	CALC. No.
DOA	5395-M-04

SUBJECT: CAMERON ST. ENERGY AUDIT. BUILDING. No. 3

PROBLEM:

DETERMINE ENERGY SAVED BY RE-SCHEDULING AHU OPERATION

- EXISTING SCHEDULE = 5:00 AM - 5:00 PM
- PROPOSE SCHEDULE = 6:00 AM - 5:00 PM HEATING
  & 8:00 AM - 5:00 PM. COOLING

CHECKER'S REMARKS:

APPROACH/ASSUMPTIONS:

PER CALC.

CHECKER'S REMARKS:

SOURCES-DATA/EQUATIONS:

PER CALC.

CHECKER'S REMARKS:

CONCLUSIONS:

TOTAL ELECTRICAL SAVINGS = 17.2×10^3 KWH/YR ≅ $688 (FY 81)

TOTAL THERMAL SAVINGS = 121 MBTU/YR (HTG) = $1032

96 MBTU/YR (CLG) = $190

TOTAL (FY 81) = $1850/YR

CHECKER'S REMARKS:

CALCULATED BY	DATE
D. STUDLEY	1/12/81
CHECKED BY	DATE
for A. Lelko	6.12.81

NUS CORPORATION

DATE 1/21/81

CLIENT DOA FILE NO. 5395 BY D. STUDLEY

SUBJECT COMEROH STATION ENERGY AUDIT Checked By Glenn A. Zelko

FAN SET-BACKS

(1). EXISTING CONDITIONS - APPROXIMATELY 20% OF FANS ARE OPERATING CONTINUOUSLY

(2) TOTAL FAN ENERGY CONSUMPTION.

TOTAL DELIVERED AIR = 137,560 CFM

AVE. S.P. = 2.75 " H_2O TOTL

$$\text{EST. BHP} = \frac{137{,}560 \times 2.75}{6356 \times 0.7} = 85 \text{ HP.}$$

$\cong$ 85 KW

(3). YEARLY FAN ENERGY PER DESIGN OPERATION

(I.E. 5:00 AM TO 5:00 PM)

$$= 85 \text{ KW} \times \frac{12 \text{ HR}}{\text{DAY}} \times 22 \frac{\text{day}}{\text{MONTH}} \times 12 \text{ MO.} = 269 \times 10^3 \text{ KWH/YR.}$$

ACTUAL FAN ENERGY (20% RUNNING CONTINUOUS)

$$= 85 \text{ KW} \times 0.2 \times (8760 \text{ hours} - 12 \times 22 \times 12) + 269 \times 10^3 \text{ KWH/YR}$$

364×10^3 KWH/YR

(4). RESTORING TIME CLOCKS SAVE.

95×10^3 KWH/YR. $\cong$ 380 (FY81)

(5) SAVINGS FOR 1 HOUR LATER START-UP (FAN ENERGY)

(6:00 AM TO 5:00 PM)

$$269 \times 10^3 \text{ KWH/YR} \times \frac{1 \text{ HR}}{12 \text{ HR}} = 22 \times 10^3 \text{ KWH/YR}$$

$\cong$ \$890/YR

NUS CORPORATION

DATE 1/21/81

CLIENT DOA FILE NO. 5395 BY D. STUPLET

SUBJECT CAHEROH STATION ENERGY AUDIT Checked By A. Zelko

SUMMARY OF FAN ENERGY SAVINGS FOR OPERATING FANS AS FOLLOWS:

HEATING SEASON SCHEDULE 6:00 AM TO 5:00 PM
COOLING SEASON SCHEDULE 8:00 AM TO 5:00 PM.

FAN ENERGY SAVINGS
$= 22.4 \times 10^3$ KWH/YR/HOUR × 2 HOUR
$= 44.8 \times 10^3$ KWH/YR
$= \$179.2$ (FY81)

THERMAL ENERGY SAVINGS FOR FAN SET-BACKS

USING DOE II OUTPUT.

HEATING LOAD - BASE RUN = 2203.7×10^6 BTU/YR
1 HOUR SET-BACK = 2082.7×10^6 BTU/YR

SAVINGS (HTG.) = 121×10^6 BTU/YR
$= \$905$/YR (80) $= \$1032$/YR (81)

COOLING LOAD -
BASE RUN = 1200.9×10^6 BTU/YR
3 HOUR SET-BACK = 1164.9×10^6 BTU/YR

36.0×10^6 BTU/YR

SAVINGS = \$130/YR (FY81)

TOTAL SAVINGS = 95×10^3 KWH (RESTORING) = \$3800/YR
22.4×10^3 KWH (NEW SCHEDULE) = \$1792/YR
THERMAL (HTG) = \$1032/YR
THERMAL (CLG) = \$130/YR
\$6750/YR

MODIFICATION No. 5

CLIENT	CALC. No.
DOA	5995-M-05

SUBJECT: CAMERON STATION ENERGY AUDIT BUILDING No. 3

PROBLEM:

ANALYZE POSSIBLE ENERGY SAVINGS BY RELOCATING THERMOSTAT. RELOCATION DUE TO UNEVEN SPACE HEATING (OVER HEATING OF INTERIOR ZONES).

CHECKER'S REMARKS:

APPROACH/ASSUMPTIONS:

1). ONLY 10% OF EXCESS ENERGY IS DUMPED.

2). EXCESS SPACE TEMP. INCREASES HEAT FLUX THRU CEILING

CHECKER'S REMARKS:

SOURCES-DATA/EQUATIONS:

MECHANICAL DRAWINGS

CHECKER'S REMARKS:

CONCLUSIONS:

RELOCATING THE THERMOSTAT COULD SAVE 10.5 MBTU/YR AT A TOTAL COST OF $560.

CHECKER'S REMARKS:

CALCULATED BY	DATE
D. FINDLEY.	11/21/81
CHECKED BY	DATE
G.A. Gilke	6.12.81

ED-501 (2/80)

NUS CORPORATION

DATE 1/21/81

CLIENT DOA FILE NO 5395 BY D. STUDLEY

SUBJECT CAMERON STATION ENERGY AUDIT #3 Checked By G.A. Welko

THERMOSTAT RELOCATION

DESCRIPTION — THE PRESENT SYSTEM PROVIDES TWO SOURCES OF HEATING FOR EACH ZONE. THE MAIN HEAT SOURCE IS SUPPLIED AT THE AIR HANDLING UNIT. ADDITIONAL HEAT IS SUPPLIED TO THE DUCT BRANCH SERVING THE PERIMETER ZONE

DEFICIENCY — BOTH THERMOSTATS CONTROLLING THE SYSTEM TEMPERATURE AND THE DUCT HEATERS ARE LOCATED IN AN EXTERIOR ROOM. THE LOGIC BEHIND THIS CONCEPT, IS TO SUPPLY ADDITIONAL HEAT TO THE EXTERIOR ROOM WHEN THE SYSTEM CAPACITY IS INADEQUATE, BUT THIS TYPE OF CONTROL SCHEME RESULTS IN SPACE TEMPERATURES EXCESSIVE IN INTERIOR SPACES.

SOLUTION — RELOCATE THERMOSTAT TO INTERIOR ZONE ; LEAVE DUCT HEATER THERMOSTAT IN EXTERIOR ZONE.

QUANTIFICATION —

ANALYSIS OF AHU #6 (TYP.)

Typ Load For Exterior Space @ 12°F outdoor

SPACE RECIEVES 1.14 CFM/S.F OR USE 120 CFM FOR 100 S.F.

- INTERNAL = 3.45 WATTS/S.F x 3.41 x 100 SF = +1176 BTUH
- WALL LOAD = 10 x 9 x (0.281) x (68-12) = -1416 "
- CEILING LOAD = 100 x (0.206) x (68-35) = -679.8 "

EXT. RM. LOAD = -920 BTUH.

NUS CORPORATION

DATE 1/21/81

CLIENT DOA FILE NO 3395 BY D. STUDLEY

SUBJECT CAMERON ST. ENERGY AUDIT #3 Checked By G.A. Velko

THERMOSTAT RELOCATION

WHAT Supply Air Temp. SATISFIES EXTERIOR ZONE.

Load = 920 BTUH.

cfm = 120 cfm

$920 = (x - 68)(1.08)(120)$

$x = 75°F$ $\Delta T = 7.1°F$

TOTAL EXTERIOR AREA OF AHU #6 = 2762 S.F.

TOTAL INTERIOR AREA OF AHU # 6 = 2645 S.F.

HEAT LOSS OF EXTERIOR ZONE (AHU #6)

Q walls = (119.5 x 9)(0.281)(56) = 16,924 BTUH

Q ceiling = (2762 S.F)(0.206)(68-35) = 18,774 "

Q gains = (2762 S.F)(3.45)(3.41) = -32,500 "

Q floor = 2 BTUH/S.F x 2762 = 5524 "

Load = 8724 BTUH

DELIVERED CFM = 2725 cfm

$\Delta T = 8724/2725(1.08) = 3.0°F$

HEAT LOSS OF INTERIOR ZONE

Q walls = 0

Q ceiling = 2645 (0.206)(68-35) = +17980 BTUH

Q floor = 2 x 2645 = +5290 "

* Q internal = 2645 x 3.45 x 3.41 = -31,100 BTUH @ 3.45 w/S.F.

Q internal = 2645 x 1.5 x 3.41 = -13,530 BTUH @ 1.5 w/S.F.

NET LOAD = 7830 BTUH @ 3.45 w/S.F. (Heat Gain)

*USE 3.45 w/S.F. (FROM KWH METERS)

+ Approx. 10 people = 9830 BTUH

NUS CORPORATION

DATE 1/21/81

CLIENT DOA FILE NO. 5395 BY D. STUDLEY

SUBJECT CALCASIEU ST. ENERGY AUDIT #3 Checked By G.A. Zelko

THERMOSTAT RELOCATION

INTERIOR ZONE - EXCESS HEAT

INTERNAL GAIN = 7830 BTUH
DELIVERED CFM = 2190 CFM
HEAT GAIN = 2190 x 1.08 x 3.0°F = 7098 BTUH
TOTAL = 16,835 BTUH

POSSIBLE SAVINGS (AHU #6)

(1) 90% OF EXCESS HEAT IS RECIRCULATED, 10% IS LOST OR DUMPED
(2) INCREASE HEAT FLOW RATE THRU CEILING (9°F)
(3) 500 HOUR OCCURANCE

HEAT WASTED = 0.1 x 16835 = 1684 BTUH
+ 0.206 (2649 X 9°F) = 2180 BTUH
3863 BTUH

YEARLY SAVINGS = 500 x 3863 = 1.93 x 10^6 BTU/yr. (AHU #6)
OR 730 BTU/yr/S.F.

UNIT NO.	INTERIOR AREA	x 730 BTU/yr/S.F	SAVINGS
AHU #4	2600 S.F.	x 730 "	= 1.9 x 10^6 BTU/yr
AHU #1	1500 "	"	1.1 "
AHU #3	2100 "	"	1.53 "
AHU #6	2650 "	"	1.93 "
AHU #7	820 "	"	0.60 "
AHU #13	2360 "	"	1.72 "
AHU #15	2300 "	"	1.68 "

TOTAL SAVINGS = 10.5 x 10^6 BTU/yr

COST ESTIMATE

ACTIVITY AND LOCATION: CAMERON ST. ENERGY AUDIT BLDG. NO. 3

PROJECT TITLE: MOD. #5. RELOCATE MASTER THERMOSTAT

NUS CORPORATION

STATUS OF DESIGN: ☐ PID ☐ 30% ☐ 100% ☐ FINAL ☐ Other (Specify) _____

Pg. 4 of 4

1/21/81

D. STORLEY

ITEM DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	MATERIAL COST UNIT COST	MATERIAL COST TOTAL	LABOR COST UNIT COST	LABOR COST TOTAL	ENGINEERING ESTIMATE UNIT COST	ENGINEERING ESTIMATE TOTAL
PER VENDOR CONTRCTS, COST TO								
INSTALL PNEUMATIC TUBING @ $1-$2/FT								
(INCLUDING O+P) · UTILIZE EXISTING								
TUBING AND USE $2.00/FT								
= 7 UNITS @ 20 FT. @ $2.00/FT								
= $280								
ADD 100% FOR FEILD CONDITIONS								
= $560								
Bare Costs:								
Contingency:								
Overhead + Profits:								
Subtotal:								$560
Escalation:								
Construction Budget								
Design Fee:								

APPENDIX B

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 11.21.15. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-G ZONE MONTHLY LOADS SUMMARY FOR Z-1 IN BSYS

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-322.378	28	7	36F	35F	-2751.916	99184.	451.
FEB	0.00000					0.000	-189.691	25	6	40F	40F	-2751.916	85659.	451.
MAR	0.00000					0.000	-141.013	11	7	35F	31F	-2751.916	94676.	451.
APR	79.40198	24	16	88F	69F	1476.279	-64.610	1	5	40F	36F	-2751.916	99184.	451.
MAY	180.25013	15	16	87F	72F	1651.877	0.000					0.000	99184.	451.
JUN	285.03730	18	16	94F	76F	1983.702	0.000					0.000	90167.	451.
JUL	362.02157	22	16	99F	75F	2115.838	0.000					0.000	99184.	451.
AUG	324.67035	16	16	92F	69F	1922.670	0.000					0.000	99184.	451.
SEP	241.03387	3	16	92F	73F	1826.393	0.000					0.000	90167.	451.
OCT	88.07552	9	16	73F	62F	1154.531	-40.863	29	6	38F	35F	-2751.916	99184.	451.
NOV	0.00000					0.000	-78.283	11	5	31F	28F	-2592.791	90167.	451.
DEC	0.00000					0.000	-201.249	30	7	32F	30F	-2751.916	94676.	451.
TOTAL	1560.491						-1038.088						1140616.	
MAX						2115.838						-2751.916		451.

MODIFICATION - $U_{CEILING} = 0.06$
SYSTEM TYPE = SUM

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 11.14.34. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-G ZONE MONTHLY LOADS SUMMARY FOR Z-1 — IN BSYS

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELECTRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-396.803	28	8	36F	35F	-2829.538	99184.	451.
FEB	0.00000					0.000	-242.504	25	7	41F	40F	-2829.538	85659.	451.
MAR	0.00000					0.000	-187.766	25	5	41F	33F	-2829.538	94676.	451.
APR	65.87256	24	16	88F	69F	1425.594	-87.171	15	6	34F	29F	-2829.538	99184.	451.
MAY	160.92691	15	16	87F	72F	1623.852	0.000					0.000	99184.	451.
JUN	272.93135	18	16	94F	76F	1965.427	0.000					0.000	90167.	451.
JUL	351.53935	22	16	99F	75F	2093.361	0.000					0.000	99184.	451.
AUG	309.54203	16	16	92F	69F	1895.596	0.000					0.000	99184.	451.
SEP	224.84233	3	16	92F	73F	1789.923	0.000					0.000	90167.	451.
OCT	63.65479	9	16	73F	62F	1052.387	-58.487	29	7	40F	36F	-2829.538	99184.	451.
NOV	0.00000					0.000	-116.473	25	5	45F	39F	-2829.538	90167.	451.
DEC	0.00000					0.000	-264.259	30	7	32F	30F	-2829.538	94676.	451.
TOTAL	1449.309						-1353.463						1140616.	
MAX						2093.361						-2829.538		451.

MODIFICATION - $U_{CEILING} = 0.09$
SYSTEM TYPE = SUM.

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 01/02/81 15.57.42. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-G ZONE MONTHLY LOADS SUMMARY FOR Z-1 IN BSYS

	COOLING					HEATING					ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELECTRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-247.033	28	7	36F	35F	-2683.703	99184.	451.
FEB	0.00000					0.000	-138.013	19	7	48F	40F	-2683.703	85659.	451.
MAR	0.00000					0.000	-96.087	11	6	33F	29F	-2683.703	94676.	451.
APR	97.83795	24	16	88F	69F	1527.127	-43.914	1	5	40F	36F	-2250.626	99184.	451.
MAY	201.31379	15	16	87F	72F	1677.662	0.000					0.000	99184.	451.
JUN	297.44879	18	16	94F	76F	1999.551	0.000					0.000	90167.	451.
JUL	372.33961	22	16	99F	75F	2137.259	0.000					0.000	99184.	451.
AUG	339.90478	1	16	90F	69F	1947.406	0.000					0.000	99184.	451.
SEP	258.47114	3	16	92F	73F	1863.363	0.000					0.000	90167.	451.
OCT	117.32649	9	16	73F	62F	1257.113	-25.417	29	5	39F	35F	-2377.376	99184.	451.
NOV	0.00000					0.000	-42.528	11	5	31F	28F	-1892.352	90167.	451.
DEC	0.00000					0.000	-138.594	30	5	32F	30F	-2683.703	94676.	451.
TOTAL	1684.643						-731.587						1140616.	
MAX						2137.259						-2683.703		451.

MODIFICATION – $U_{CEILING}$ = 0.03
SYSTEM TYPE - SUM

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 09.40.15. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-G ZONE MONTHLY LOADS SUMMARY FOR Z-1 IN BSYS

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELECTRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-584.862	29	6	35F	35F	-3097.685	99184.	451.
FEB	0.00000					0.000	-378.781	25	8	40F	40F	-3097.685	85659.	451.
MAR	0.00000					0.000	-314.691	25	7	38F	31F	-3097.685	94676.	451.
APR	42.82269	24	16	88F	69F	1278.857	-153.507	15	7	35F	30F	-3097.685	99184.	451.
MAY	117.82697	15	16	87F	72F	1529.258	0.000					0.000	99184.	451.
JUN	241.35325	18	16	94F	76F	1899.199	0.000					0.000	90167.	451.
JUL	321.95091	22	16	99F	75F	2021.474	0.000					0.000	99184.	451.
AUG	269.59894	16	16	92F	69F	1806.065	0.000					0.000	99184.	451.
SEP	184.99686	3	16	92F	73F	1687.100	0.000					0.000	90167.	451.
OCT	22.35475	9	16	73F	62F	792.778	-119.252	29	8	39F	35F	-3097.685	99184.	451.
NOV	0.00000					0.000	-224.960	25	7	44F	39F	-3097.685	90167.	451.
DEC	0.00000					0.000	-427.662	31	5	32F	31F	-3097.685	94676.	451.
TOTAL	1200.90#						-2203.715						1140616.	
MAX						2021.474						-3097.685		451.

BASELINE RUN

SYSTEM- SUM

EXISTING CONDITIONS, U-VALUE OF CEILING = 0.204

INFILTRATION = 0.162 CFM/S.F 5:00 AM - 5:00 PM

= 0.097 CFM/S.F 5:00 PM - 5:00 AM

HVAC EQUIP. SCHEDULE 5:00 AM - 5:00 PM.

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 01/06/81 15.49.27. SDL RUN 1
DECEMBER 1980 — SYSTEM SZRH
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-360.565	18	6	9F	9F	-3389.057	120466.	531.
FEB	0.00000					0.000	-193.695	20	6	25F	23F	-2999.293	104038.	531.
MAR	0.00000					0.000	-140.770	4	8	29F	25F	-2985.455	114990.	531.
APR	77.09242	26	15	74F	66F	2698.830	-55.522	15	6	34F	29F	-2928.659	120466.	531.
MAY	209.16250	14	9	73F	70F	3338.456	0.000					0.000	120466.	531.
JUN	463.98030	25	15	74F	72F	5168.567	0.000					0.000	109514.	531.
JUL	538.86212	9	7	74F	72F	5166.824	0.000					0.000	120466.	531.
AUG	421.04688	12	8	74F	70F	4537.398	0.000					0.000	120466.	531.
SEP	355.98798	4	9	74F	72F	4784.512	0.000					0.000	109514.	531.
OCT	17.57899	9	16	73F	62F	1655.672	-38.671	29	6	38F	35F	-2830.926	120466.	531.
NOV	0.00000					0.000	-85.043	11	6	31F	27F	-3003.032	109514.	531.
DEC	0.00000					0.000	-216.667	30	6	32F	29F	-2936.705	114990.	531.
TOTAL	2083.711						-1090.932						1385355.	
MAX						5168.567						-3389.057		531.

SINGLE - ZONE w/ ECONOMIZER
MODIFIED HVAC SCHEDULE
HEATING 6:00 AM, COOLING 8:00 AM

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 01/02/81 16.24.33. SOL RUN 1
DECEMBER 1980 — SYSTEM SZRH AND SYSTEM FPH
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR PLNT-1

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELECTRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-370.028	2	5	17F	15F	-6000.628	122230	531.
FEB	0.00000					0.000	-250.981	19	5	49F	40F	-4710.977	105970.	531.
MAR	0.00000					0.000	-223.333	4	5	29F	26F	-4643.078	116683.	531.
APR	17.43875	24	17	85F	70F	983.082	-155.372	15	5	34F	30F	-4145.212	122239.	531.
MAY	55.94395	15	16	87F	72F	998.305	0.000					0.000	122239.	531.
JUN	129.39809	14	16	91F	76F	1513.683	0.000					0.000	111126.	531.
JUL	141.57809	31	16	90F	72F	1343.714	0.000					0.000	122239.	531.
AUG	124.00251	30	16	91F	73F	1431.411	0.000					0.000	122239.	531.
SEP	79.78284	13	16	88F	76F	1445.059	0.000					0.000	111126.	531.
OCT	3.73760	9	16	73F	62F	733.054	-118.148	29	5	39F	35F	-4223.414	122239.	531.
NOV	0.00000					0.000	-165.135	11	5	31F	28F	-4126.212	111126.	531.
DEC	0.00000					0.000	-275.020	30	5	32F	30F	-4398.108	116683.	531.
TOTAL	551.882						-1558.019						1405750.	
MAX						1513.683						-6000.628		531.

BASELINE RUN FOR SINGLE ZONE SYSTEM
W/ ECONOMIZER
SIMILAR ZONING W/ SUM RUNS FOR COMPARISON
OF ECONOMIZER SAVINGS

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/23/80 09.08.23. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-G ZONE MONTHLY LOADS SUMMARY FOR Z-1 IN BSYS

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-292.709	28	8	36F	35F	-2751.916	99184.	451.
FEB	0.00000					0.000	-168.226	25	7	41F	40F	-2751.916	85659.	451.
MAR	0.00000					0.000	-118.707	25	7	38F	31F	-2751.916	94676.	451.
APR	73.20523	24	16	88F	69F	1470.604	-47.772	15	7	35F	30F	-2751.916	99184.	451.
MAY	179.50102	15	16	87F	72F	1664.308	0.000					0.000	99184.	451.
JUN	280.74348	18	16	94F	76F	2042.947	0.000					0.000	90167.	451.
JUL	355.71714	22	16	99F	75F	2173.460	0.000					0.000	99184.	451.
AUG	319.95995	1	16	90F	69F	1967.602	0.000					0.000	99184.	451.
SEP	238.32526	3	16	92F	73F	1854.186	0.000					0.000	90167.	451.
OCT	82.40197	9	16	73F	62F	1142.746	-27.572	29	7	40F	36F	-2751.916	99184.	451.
NOV	0.00000					0.000	-60.215	11	7	30F	27F	-2751.916	90167.	451.
DEC	0.00000					0.000	-176.985	30	7	32F	30F	-2751.916	94676.	451.
TOTAL	1529.854						-892.187						1140616.	
MAX						2173.460						-2751.916		451.

MODIFICATION. $U_{CEILING}$ = 0.06 & HVAC SCHED.
AT 7:00 AM – 5:00 PM
SYSTEM - SUM.

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 11.23.55. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-G ZONE MONTHLY LOADS SUMMARY FOR Z-1 IN BSYS

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELECTRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-350.194	31	7	34F	33F	-1472.113	99184.	451.
FEB	0.00000					0.000	-235.875	26	7	53F	53F	-1472.113	85659.	451.
MAR	0.00000					0.000	-192.674	26	7	40F	36F	-1472.113	94676.	451.
APR	47.08136	30	16	79F	57F	1108.518	-94.700	16	7	40F	38F	-1472.113	99184.	451.
MAY	129.13253	15	16	87F	72F	1316.536	0.000					0.000	99184.	451.
JUN	225.64832	18	16	94F	76F	1572.183	0.000					0.000	90167.	451.
JUL	299.95453	22	16	99F	75F	1620.018	0.000					0.000	99184.	451.
AUG	262.41217	1	16	90F	69F	1536.979	0.000					0.000	99184.	451.
SEP	189.52320	13	16	88F	76F	1426.097	0.000					0.000	90167.	451.
OCT	39.14437	9	16	73F	62F	792.037	-71.559	30	7	49F	43F	-1472.113	99184.	451.
NOV	0.00000					0.000	-134.722	29	7	57F	55F	-1472.113	90167.	451.
DEC	0.00000					0.000	-269.252	31	9	32F	30F	-1472.113	94676.	451.
TOTAL	1192.896						-1348.976						1140616.	
MAX						1620.018						-1472.113		451.

B-R

MODIFICATION- INFILTRATION @ 0.037 CFM/S.F.
TO DETERMINE LOAD/CFM OF O.A.
SYSTEM - SUM

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 14.02.01. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-G ZONE MONTHLY LOADS SUMMARY FOR Z-1 IN BSYS

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELECTRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-498.387	29	8	35F	35F	-3097.685	99184.	451.
FEB	0.00000					0.000	-321.600	25	10	44F	44F	-3097.685	85659.	451.
MAR	0.00000					0.000	-259.459	25	8	38F	31F	-3097.685	94676.	451.
APR	37.33023	24	17	85F	70F	1242.784	-113.458	15	9	41F	35F	-3097.685	99184.	451.
MAY	117.52396	15	16	87F	72F	1530.313	0.000					0.000	99184.	451.
JUN	235.60573	18	16	94F	76F	1982.620	0.000					0.000	90167.	451.
JUL	313.66563	22	16	99F	75F	2101.633	0.000					0.000	99184.	451.
AUG	264.72144	16	16	92F	69F	1851.789	0.000					0.000	99184.	451.
SEP	183.00495	3	16	92F	73F	1706.838	0.000					0.000	90167.	451.
OCT	13.04426	9	16	73F	62F	675.856	-74.697	29	10	47F	42F	-3097.685	99184.	451.
NOV	0.00000					0.000	-176.463	25	9	44F	39F	-3097.685	90167.	451.
DEC	0.00000					0.000	-361.520	31	8	31F	30F	-3097.685	94676.	451.
TOTAL	1164.896						-1805.584						1140616.	
MAX						2101.633						-3097.685		451.

MODIFICATION - HVAC SCHED. 8:00 AM - 5:00 PM
SYSTEM - SUM.

CAMERUN STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 13.59.30. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-G ZONE MONTHLY LOADS SUMMARY FOR Z-1 — IN BSYS

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-529.009	29	7	35F	35F	-3097.685	99184.	451.
FEB	0.00000					0.000	-342.041	25	9	43F	43F	-3097.685	85659.	451.
MAR	0.00000					0.000	-279.584	25	8	38F	31F	-3097.685	94676.	451.
APR	39.41761	24	17	85F	70F	1259.061	-128.376	15	8	38F	32F	-3097.685	99184.	451.
MAY	117.59557	15	16	87F	72F	1530.313	0.000					0.000	99184.	451.
JUN	237.52974	18	16	94F	76F	1952.072	0.000					0.000	90167.	451.
JUL	316.41667	22	16	99F	75F	2072.874	0.000					0.000	99184.	451.
AUG	266.19185	16	16	92F	69F	1835.413	0.000					0.000	99184.	451.
SEP	183.57694	3	16	92F	73F	1699.652	0.000					0.000	90167.	451.
OCT	16.61118	9	16	73F	62F	730.267	-92.103	29	9	42F	38F	-3097.685	99184.	451.
NOV	0.00000					0.000	-194.082	25	8	44F	39F	-3097.685	90167.	451.
DEC	0.00000					0.000	-384.662	31	7	31F	29F	-3097.685	94676.	451.
TOTAL	1177.340						-1949.857						1140616.	
MAX						2072.874						-3097.685		451.

MODIFICATION - HVAC SCHED. 7:00 AM. 5:00 PM
SYSTEM - SUM

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 13.57.54. SUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-G ZONE MONTHLY LOADS SUMMARY FOR Z-1 IN BSYS

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-557.862	29	7	35F	35F	-3097.685	99184.	451.
FEB	0.00000					0.000	-361.220	25	8	40F	40F	-3097.685	85659.	451.
MAR	0.00000					0.000	-297.937	25	7	38F	31F	-3097.685	94676.	451.
APR	41.21513	24	16	88F	69F	1271.249	-141.691	15	7	35F	30F	-3097.685	99184.	451.
MAY	117.66603	15	16	87F	72F	1530.313	0.000					0.000	99184.	451.
JUN	239.44532	18	16	94F	76F	1924.215	0.000					0.000	90167.	451.
JUL	319.18033	22	16	99F	75F	2046.301	0.000					0.000	99184.	451.
AUG	267.79778	16	16	92F	69F	1820.396	0.000					0.000	99184.	451.
SEP	184.23225	3	16	92F	73F	1693.039	0.000					0.000	90167.	451.
OCT	19.75329	9	16	73F	62F	767.105	-106.875	29	9	42F	38F	-3097.685	99184.	451.
NOV	0.00000					0.000	-210.281	25	7	44F	39F	-3097.685	90167.	451.
DEC	0.00000					0.000	-406.858	31	7	31F	29F	-3097.685	94676.	451.
TOTAL	1189.310						-2082.723						1140616.	
MAX						2046.301						-3097.685		451.

MODIFICATION - HVAC SCHED. 6:00 AM - 5:00 PM
SYSTEM TYPE = SUM

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 01/06/81 12.28.34. SDL RUN 1
DECEMBER 1980 — SYSTEM SZRH
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELECTRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-288.296	2	9	20F	17F	-3123.940	122239.	531.
FEB	0.00000					0.000	-151.624	4	5	45F	44F	-2739.415	105570.	531.
MAR	0.00000					0.000	-107.231	4	5	29F	26F	-3033.252	116683.	531.
APR	76.87888	26	15	74F	66F	2614.495	-43.897	15	5	34F	30F	-2555.131	122239.	531.
MAY	205.55619	14	9	73F	70F	3087.642	0.000					0.000	122239.	531.
JUN	470.43649	25	15	74F	72F	4751.419	0.000					0.000	111126.	531.
JUL	541.33182	9	7	74F	72F	4315.828	0.000					0.000	122239.	531.
AUG	421.70655	12	8	74F	70F	3969.176	0.000					0.000	122239.	531.
SEP	358.82694	4	9	74F	72F	4286.020	0.000					0.000	111126.	531.
OCT	20.33835	9	16	73F	62F	1692.035	-29.911	29	5	39F	35F	-2709.526	122239.	531.
NOV	0.00000					0.000	-60.378	11	5	31F	28F	-2539.386	111126.	531.
DEC	0.00000					0.000	-162.847	30	5	32F	30F	-3003.438	116683.	531.
TOTAL	2095.075						-844.184						1405750.	
MAX						4751.419						-3123.940		531.

SINGLE-ZONE W/ ECONOMIZER
ROOF TREATED AS ATTIC SPACE
MODIFIED - U_{ROOF} = 0.072
3" INSULATION

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 01/06/81 11.21.09. SDL RUN 1
DECEMBER 1980 — SYSTEM SZRH
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-384.538	18	5	9F	8F	-3402.438	122239.	531.
FEB	0.00000					0.000	-210.667	11	5	36F	34F	-2902.269	105570.	531.
MAR	0.00000					0.000	-156.812	4	5	29F	26F	-2968.115	116683.	531.
APR	77.06356	26	15	74F	66F	2689.194	-64.824	15	5	34F	30F	-2932.493	122239.	531.
MAY	211.02245	14	9	73F	70F	3175.014	0.000					0.000	122239.	531.
JUN	494.46156	25	15	74F	72F	4952.081	0.000					0.000	111126.	531.
JUL	574.72640	9	7	74F	72F	4474.349	0.000					0.000	122239.	531.
AUG	435.85897	12	8	74F	70F	4163.102	0.000					0.000	122239.	531.
SEP	365.59173	4	9	74F	72F	4374.892	0.000					0.000	111126.	531.
OCT	17.72863	9	16	73F	62F	1658.557	-45.515	29	6	38F	35F	-2822.709	122239.	531.
NOV	0.00000					0.000	-97.031	11	5	31F	28F	-3007.399	111126.	531.
DEC	0.00000					0.000	-235.271	30	5	32F	30F	-2943.771	116683.	531.
TOTAL	2176.453						-1194.659						1405750.	
MAX						4952.081						-3402.438		531.

BASELINE RUN FOR SINGLE-ZONE SYSTEM
W/ ECONOMISER
ROOF TREATED AS AN ATTIC SPACE W/
U= 0.127 - EXISTING CONDITION

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 01/06/81 12.40.24. SDL RUN 1
DECEMBER 1980 — SYSTEM SZRH
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-247.340	2	9	20F	17F	-3163.110	122239.	531.
FEB	0.00000					0.000	-125.617	19	5	49F	40F	-2651.606	105570.	531.
MAR	0.00000					0.000	-85.931	4	5	29F	26F	-2987.158	116683.	531.
APR	76.90150	26	15	74F	66F	2580.454	-35.160	15	5	34F	30F	-2271.128	122239.	531.
MAY	203.24373	14	9	73F	70F	3050.256	0.000					0.000	122239.	531.
JUN	456.54141	25	15	74F	72F	4666.713	0.000					0.000	111126.	531.
JUL	527.16493	9	7	74F	72F	4243.341	0.000					0.000	122239.	531.
AUG	415.70054	12	8	74F	70F	3878.763	0.000					0.000	122239.	531.
SEP	355.85771	12	8	74F	73F	4256.362	0.000					0.000	111126.	531.
OCT	21.68212	9	16	73F	62F	1703.636	-23.930	29	5	39F	35F	-2369.876	122239.	531.
NOV	0.00000					0.000	-48.269	11	5	31F	28F	-2174.894	111126.	531.
DEC	0.00000					0.000	-132.566	30	5	32F	30F	-2668.623	116683.	531.
TOTAL	2057.092						-698.813						1405750.	
MAX						4666.713						-3163.110		531.

SINGLE-ZONE W/ECONOMIZER
ROOF TREATED AS ATTIC SPACE
MODIFIED - U_{ROOF} = 0.05
(3" INSULATION)

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 01/06/81 13.32.16. SDL RUN 1
DECEMBER 1980 — SYSTEM SZRH
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-203.729	2	8	19F	16F	-3178.189	122239.	531.
FEB	0.00000					0.000	-98.071	19	5	49F	40F	-2680.891	105570.	531.
MAR	0.00000					0.000	-65.879	4	5	29F	26F	-2551.643	116683.	531.
APR	77.01557	26	15	74F	66F	2543.489	-27.368	15	5	34F	30F	-1961.565	122239.	531.
MAY	200.92705	14	9	73F	70F	3011.274	0.000					0.000	122239.	531.
JUN	445.95273	25	15	74F	72F	4579.029	0.000					0.000	111126.	531.
JUL	512.91336	9	7	74F	72F	4164.703	0.000					0.000	122239.	531.
AUG	409.37317	12	8	74F	70F	3779.332	0.000					0.000	122239.	531.
SEP	351.40210	12	8	74F	73F	4255.444	0.000					0.000	111126.	531.
OCT	23.21325	9	16	73F	62F	1716.229	-18.698	29	5	39F	35F	-1991.037	122239.	531.
NOV	0.00000					0.000	-36.729	11	5	31F	28F	-1783.012	111126.	531.
DEC	0.00000					0.000	-101.016	30	5	32F	30F	-2249.732	116683.	531.
TOTAL	2020.797						-551.491						1405750.	
MAX						4579.029						-3178.189		531.

SINGLE-ZONE W/ECONOMIZER
ROOF TREATED AS ATTIC SPACE
MODIFIED U-ROOF = 0.0275
(9" INSULATION)

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/23/80 09.08.23. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELECTRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-381.827	18	7	10F	9F	-5959.663	99184.	451.
FEB	0.00000					0.000	-169.573	21	7	27F	25F	-2762.628	85659.	451.
MAR	0.00000					0.000	-118.852	4	7	28F	24F	-2836.444	94676.	451.
APR	73.82524	24	16	88F	69F	1470.604	-47.772	15	7	35F	30F	-2751.916	99184.	451.
MAY	187.31727	14	16	88F	73F	2383.600	0.000					0.000	99184.	451.
JUN	370.98842	18	12	93F	77F	3885.333	0.000					0.000	90167.	451.
JUL	459.00789	22	15	99F	75F	4142.043	0.000					0.000	99184.	451.
AUG	360.80996	2	13	86F	67F	3862.384	0.000					0.000	99184.	451.
SEP	250.65317	3	15	91F	73F	2835.783	0.000					0.000	90167.	451.
OCT	82.40197	9	16	73F	62F	1142.746	-27.572	29	7	40F	36F	-2751.916	99184.	451.
NOV	0.00000					0.000	-60.235	11	7	30F	27F	-2751.916	90167.	451.
DEC	0.00000					0.000	-205.710	12	7	14F	12F	-4485.229	94676.	451.
TOTAL	1785.004						-1011.542						1140616.	
MAX						4142.043						-5959.663		451.

MODIFICATION. $U_{ceiling} = 0.06$; HVAC SCHED. AT 7:00 AM - 5:00PM
SYSTEM - SUM

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 11.23.55. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-D PLAN; MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-387.017	18	5	9F	8F	-3207.860	99184.	451.
FEB	0.00000					0.000	-235.875	26	7	53F	53F	-1472.113	85659.	451.
MAR	0.00000					0.000	-192.674	26	7	40F	36F	-1472.113	94676.	451.
APR	48.98471	29	15	75F	55F	1410.962	-94.700	16	7	40F	38F	-1472.113	99184.	451.
MAY	142.23646	14	16	88F	73F	2127.923	0.000					0.000	99184.	451.
JUN	332.93092	18	12	93F	77F	3434.644	0.000					0.000	90167.	451.
JUL	425.53147	16	16	84F	63F	3600.702	0.000					0.000	99184.	451.
AUG	318.65620	2	13	86F	67F	3619.053	0.000					0.000	99184.	451.
SEP	208.49165	3	15	91F	73F	2462.657	0.000					0.000	90167.	451.
OCT	39.14437	9	16	73F	62F	792.037	-71.559	30	7	49F	43F	-1472.113	99184.	451.
NOV	0.00000					0.000	-134.722	29	7	57F	55F	-1472.113	90167.	451.
DEC	0.00000					0.000	-272.169	13	5	20F	17F	-2053.879	94676.	451.
TOTAL	1515.976						-1388.716						1140616.	
MAX						3619.053						-3207.860		451.

MODIFICATION- INFILTRATION @ 0.037 CFM/S.F.
TO DETERMINE LOAD/CFM OF O.A.
SYSTEM- SUM

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 14.02.01. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-523.900	18	8	10F	9F	-5211.271	99184.	451.
FEB	0.00000					0.000	-321.600	25	10	44F	34F	-3097.685	85659.	451.
MAR	0.00000					0.000	-259.459	25	8	38F	31F	-3097.685	94676.	451.
APR	38.98732	24	15	86F	70F	1445.354	-113.458	15	9	41F	35F	-3097.685	99184.	451.
MAY	130.14741	14	16	88F	73F	2355.995	0.000					0.000	99184.	451.
JUN	339.96335	18	12	93F	77F	3935.842	0.000					0.000	90167.	451.
JUL	434.53660	22	15	99F	75F	4164.868	0.000					0.000	99184.	451.
AUG	319.94249	2	13	86F	67F	3898.072	0.000					0.000	99184.	451.
SEP	201.60706	3	16	92F	73F	2774.131	0.000					0.000	90167.	451.
OCT	13.04426	9	16	73F	62F	675.856	-74.697	29	10	47F	42F	-3097.685	99184.	451.
NOV	0.00000					0.000	-176.463	25	9	44F	39F	-3097.685	90167.	451.
DEC	0.00000					0.000	-364.146	13	8	20F	18F	-3911.560	94676.	451.
TOTAL	1478.228						-1833.723						1140616.	
MAX						4164.868						-5211.271		451.

MODIFICATION - HVAC SCHED. 8:00 AM - 5:00 PM
SYSTEM - SUM

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 13.59.30. SOL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-555.731	18	7	10F	9F	-5101.505	99184.	451.
FEB	0.00000					0.000	-342.041	25	9	43F	43F	-3097.685	85659.	451.
MAR	0.00000					0.000	-279.584	25	8	38F	31F	-3097.685	94676.	451.
APR	41.11607	24	15	86F	70F	1475.880	-128.376	15	8	38F	32F	-3097.685	99184.	451.
MAY	130.21895	14	16	88F	73F	2355.995	0.000					0.000	99184.	451.
JUN	342.16928	18	12	93F	77F	3869.093	0.000					0.000	90167.	451.
JUL	437.83696	22	15	99F	75F	4098.431	0.000					0.000	99184.	451.
AUG	321.13372	2	13	86F	67F	3867.270	0.000					0.000	99184.	451.
SEP	202.10614	3	16	92F	73F	2765.402	0.000					0.000	90167.	451.
OCT	16.61118	9	16	73F	62F	730.267	-92.103	29	9	42F	38F	-3097.685	99184.	451.
NOV	0.00000					0.000	-194.082	25	8	44F	39F	-3097.685	90167.	451.
DEC	0.00000					0.000	-387.338	13	7	20F	18F	-3792.551	94676.	451.
TOTAL	1491.192						-1979.254						1140616.	
MAX						4098.431						-5101.505		451.

MODIFICATION- HVAC SCHED, 7:00 AM - 5:00 PM.
SYSTEM - SUM

CAMERUN STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 13.57.54. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-585.452	18	6	9F	9F	-4967.634	99184.	451.
FEB	0.00000					0.000	-361.220	25	8	40F	40F	-3097.685	85659.	451.
MAR	0.00000					0.000	-297.937	25	7	38F	31F	-3097.685	94676.	451.
APR	42.94402	24	15	86F	70F	1497.438	-141.691	15	7	35F	30F	-3097.685	99184.	451.
MAY	130.30906	14	16	88F	73F	2355.995	0.000					0.000	99184.	451.
JUN	344.58542	18	12	93F	77F	3801.977	0.000					0.000	90167.	451.
JUL	441.42407	22	15	99F	75F	4037.101	0.000					0.000	99184.	451.
AUG	322.60566	2	13	86F	67F	3837.369	0.000					0.000	99184.	451.
SEP	202.69103	3	16	92F	73F	2757.015	0.000					0.000	90167.	451.
OCT	19.75329	9	16	73F	62F	767.105	-106.875	29	9	42F	38F	-3097.685	99184.	451.
NOV	0.00000					0.000	-210.281	25	7	44F	39F	-3097.685	90167.	451.
DEC	0.00000					0.000	-409.341	13	6	21F	18F	-3705.090	94676.	451.
TOTAL	1504.313						-2112.797						1140616.	
MAX						4037.101						-4967.634		451.

MODIFICATION - HVAC SCHED. 6:00 AM-5:00 PM
SYSTEM TYPE = SUM.

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 11.21.15. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-420.323	18	5	9F	8F	-5402.523	99184.	451.
FEB	0.00000					0.000	-191.124	25	6	40F	40F	-2751.916	85659.	451.
MAR	0.00000					0.000	-141.044	4	7	28F	24F	-2754.018	94676.	451.
APR	80.02199	24	16	88F	69F	1476.279	-64.610	1	5	40F	36F	-2751.916	99184.	451.
MAY	188.04718	14	16	88F	73F	2372.914	0.000					0.000	99184.	451.
JUN	376.50468	18	12	93F	77F	3755.579	0.000					0.000	90167.	451.
JUL	467.30305	22	15	99F	75F	4018.176	0.000					0.000	99184.	451.
AUG	365.48331	2	13	86F	67F	3789.652	0.000					0.000	99184.	451.
SEP	253.26110	3	16	92F	73F	2805.317	0.000					0.000	90167.	451.
OCT	88.07552	9	16	73F	62F	1154.531	-40.863	29	6	38F	35F	-2751.916	99184.	451.
NOV	0.00000					0.000	-78.283	11	5	31F	28F	-2592.791	90167.	451.
DEC	0.00000					0.000	-233.300	13	5	20F	17F	-3934.890	94676.	451.
TOTAL	1818.697						-1169.548						1140616.	
MAX						4018.176						-5402.523		451.

MODIFICATION – $U_{CEILING} = 0.06$
SYSTEM TYPE = SUM

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 11.14.34. BDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-470.305	18	5	9F	8F	-5363.694	99184.	451.
FEB	0.00000					0.000	-242.504	25	7	41F	40F	-2829.538	85659.	451.
MAR	0.00000					0.000	-187.766	25	5	41F	33F	-2829.538	94676.	451.
APR	66.62032	29	15	75F	55F	1458.937	-87.171	15	6	34F	29F	-2829.538	99184.	451.
MAY	169.88793	14	16	88F	73F	2371.897	0.000					0.000	99184.	451.
JUN	367.85590	18	12	93F	77F	3752.325	0.000					0.000	90167.	451.
JUL	461.06538	22	15	99F	75F	4008.123	0.000					0.000	99184.	451.
AUG	353.55661	2	13	86F	67F	3796.119	0.000					0.000	99184.	451.
SEP	238.44557	3	16	92F	73F	2791.274	0.000					0.000	90167.	451.
OCT	63.65479	9	16	73F	62F	1052.387	-58.487	29	7	40F	36F	-2829.538	99184.	451.
NOV	0.00000					0.000	-116.473	25	5	45F	39F	-2829.538	90167.	451.
DEC	0.00000					0.000	-284.792	13	5	20F	17F	-3999.114	94676.	451.
TOTAL	1721.086						-1447.498						1140616.	
MAX						4008.123						-5363.694		451.

MODIFICATION - $U_{CEILING}$ = 0.09
SYSTEM TYPE = SUM

CAMERON STATIUN ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 01/02/81 15.57.42. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-0 PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING					HEATING					ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-376.171	18	5	9F	8F	-5319.554	99184.	451.
FEB	0.00000					0.000	-145.169	19	7	48F	40F	-2683.703	85659.	451.
MAR	0.00000					0.000	-97.722	4	7	28F	24F	-2981.416	94676.	451.
APR	98.35645	24	16	88F	69F	1527.127	-43.914	1	5	40F	36F	-2250.626	99184.	451.
MAY	208.05123	14	16	88F	73F	2372.788	0.000					0.000	99184.	451.
JUN	385.76235	18	12	93F	77F	3758.484	0.000					0.000	90167.	451.
JUL	473.65393	22	15	99F	75F	4028.667	0.000					0.000	99184.	451.
AUG	377.86118	2	13	86F	67F	3783.049	0.000					0.000	99184.	451.
SEP	269.39957	3	16	92F	73F	2820.112	0.000					0.000	90167.	451.
OCT	117.32649	9	16	73F	62F	1257.113	-25.417	29	5	39F	35F	-2377.376	99184.	451.
NOV	0.00000					0.000	-43.585	11	5	31F	28F	-1892.352	90167.	451.
DEC	0.00000					0.000	-182.951	13	5	20F	17F	-3878.241	94676.	451.
TOTAL	1930.411						-914.928						1140616.	
MAX						4028.667						-5319.554		451.

MODIFICATION - $U_{CEILING} = 0.03$
SYSTEM TYPE = SUM

CAMERON STATION ENERGY AUDIT — NUS CORPORATION — DOE-2.0A 12/22/80 09.40.15. SDL RUN 1
DECEMBER 1980 — SYSTEM SUM
REPORT- SS-D PLANT MONTHLY LOADS SUMMARY FOR DEFAULT-PLANT

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-612.713	18	5	9F	8F	-4737.166	99184.	451.
FEB	0.00000					0.000	-378.781	25	8	40F	40F	-3097.685	85659.	451.
MAR	0.00000					0.000	-314.691	25	7	38F	31F	-3097.685	94676.	451.
APR	44.57278	24	15	86F	70F	1511.469	-153.507	15	7	35F	30F	-3097.685	99184.	451.
MAY	130.44567	14	16	88F	73F	2355.403	0.000					0.000	99184.	451.
JUN	347.12604	18	12	93F	77F	3740.297	0.000					0.000	90167.	451.
JUL	445.30675	22	15	99F	75F	3981.433	0.000					0.000	99184.	451.
AUG	324.34345	2	13	86F	67F	3808.774	0.000					0.000	99184.	451.
SEP	203.37852	3	16	92F	73F	2749.533	0.000					0.000	90167.	451.
OCT	22.35475	9	16	73F	62F	792.778	-119.252	29	8	39F	35F	-3097.685	99184.	451.
NOV	0.00000					0.000	-224.960	25	7	44F	39F	-3097.685	90167.	451.
DEC	0.00000					0.000	-429.758	13	5	20F	17F	-3643.114	94676.	451.
TOTAL	1517.528						-2233.663						1140616.	
MAX						3981.433						-4737.166		451.

BASELINE RUN (SUM)
EXISTING CONDITIONS, U-VALUE CEILING = 0.206
INFILTRATION = 0.162 CFM/S.F. 5:00 AM - 5:00 PM
= 0.037 CFM/S.F 5:00 PM - 5:00 AM
HVAC EQUIP. SCHEDULE = 5:00 AM - 5:00 PM

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HQDA (DAEN-MPO-U)
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HQDA (DAEN-MPZ-A)
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HQDA (DAEN-MPZ-E)
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Commanding General, 5th USA
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Ft Sam Houston, TX 78234

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Tyndall AFB, FL 32403

Commander, DARCOM
Director, Installation
and Services
5001 Eisenhower Ave.
Alexandria, VA 22333

Commander, DARCOM
ATTN: Chief, Engineering Div.
5001 Eisenhower Ave
Alexandria, VA 22333

Air Force Weapons Lab/AFWL/DE
Chief, Civil Engineering
Research Division
Kirtland AFB, NM 87117

Strategic Air Command
ATTN: DSC/CE (DEEE)
Offutt AFB, NE 68112

Headquarters USAF
Directorate of Civil Engineering
AF/PREES
Bolling AFB, Washington, DC 20333

Strategic Air Command
Engineering
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Chief, Naval Facilities
Engineer Command
ATTN: Chief Engineer
Department of the Navy
Washington, DC 20350

Commander
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Carlisle Barracks, PA 17013

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Fort Chaffee, AR 72902

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Fort McClellan, AL 36201

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Tooele Army Depot
Tooele, UT 84074

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Southport, NC 28461

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West Point Reservation
West Point, NY 10996

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Technology Center
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172d Infantry Brigade
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Aberdeen Proving Ground, MD 21005

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Madison, IN 47250

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Dugway, UT 84022

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Fort McCoy
Sparta, WI 54656

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White Sands Missile Range, NM 88002

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Fort Campbell, KY 42223

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Fort Hood
Fort Hood, TX 76544

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Fort McPherson, GA 30330

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Fort Polk, LA 71459

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Fort Riley
Fort Riley, KS 66442

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Fort Stewart
Fort Stewart, GA 31312

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Joliet, IL 60436

Facilities Engineer
Anniston Army Depot
Anniston, AL 36201

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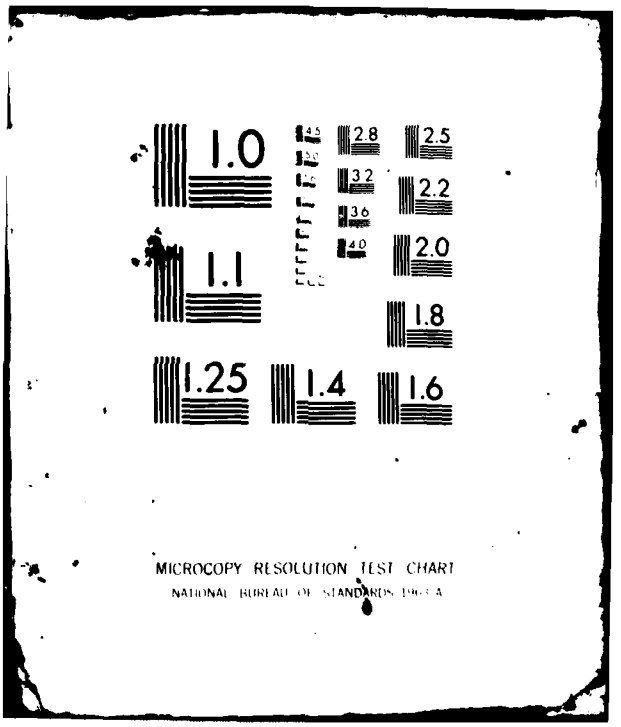
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